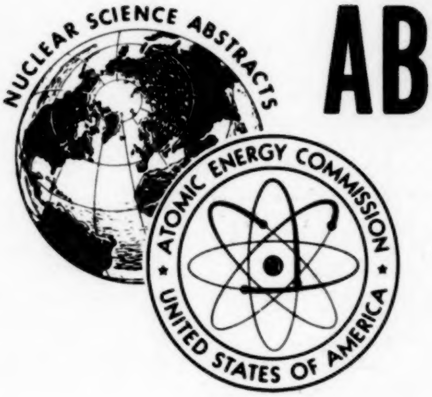
NUCLEAR SCIENCE ABSTRACTS



Volume 29 Number 10

Abstracts 23891-26543

May 31, 1974

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NUCLEAR SCIENCE ABSTRACTS

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Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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Personal Authors

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DIENSTBIER, Z., Effect of para-aminomethylbenzoic acid on the post-irradiation disturbance of haemocoagulation in dogs after whole-body exposure to 600 R, 27:20122
DIERCKX, R., Determination of the fast neutron spectrum at the L54 reactor core center, 27:21880
DIETZEL, H., HEOS 2 and HELIOS micrometeoroid experiments, 27:20588

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ACCELERATOR FACILITIES/DESIGN
  Design of a neutron therapy facility for a 30-inch cyclotron, 27:25413
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  Pulse radiolysis of alkyl ketones, 27:24388
  Radiothermoluminescence of aliphatic ketones (Gamma radiation), 27:24389
AEROSOL GENERATORS/OPERATION
  Operating characteristics of two compressed air nebulizers used in inhalation experiments, 27:24522 (LF-45)

Corporate Index

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21102 (ORNL-4846) GAMMA-RAY PRODUCTION DUE TO NEUTRON INTERACTIONS WITH COPPER FOR INCIDENT NEUTRON ENERGIES BETWEEN 1.0 AND 20 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Love, T. A.; Morgan, G. L. **(Oak Ridge National Lab., Tenn).** Feb 1973. Contract W-7405-eng-26. 44p. Dep. NTIS $4.00.

is indexed as:

OAK RIDGE NATIONAL LAB., TENN.
  Gamma-ray production due to neutron interactions with copper for incident neutron energies between 1.0 and 20 MeV: tabulated differential cross sections, 27:21102 (ORNL-4846)

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Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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Volume 29, Number 10

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 24393, 24848–24851, 24853, and 26524.

23891 DETERMINATION OF OXYGEN-TO-METAL RATIOS IN METAL OXIDE NUCLEAR FUELS. Gurumurthy, C. V. (Technische Hogeschool, Eindhoven, Netherlands). J. Appl. Chem. Biotechnol.; 23: No. 10, 725-731(Oct 1973).

Methods for the determination of O/M ratios in uranium and uranium–plutonium oxide nuclear fuels are reported based on an extensive literature survey. The salient features, as well as the merits and drawbacks of each method are critically reviewed. The need for a fast direct method, by which the simpler indirect methods may be checked, is met by the carbon-reduction method. (auth)

23892 SYMPOSIUM ON MODERN METHODS OF FUEL ANALYSIS. 163rd National Meeting of the American Chemical Society, Boston, Massachusetts, April 10–14, 1972. University Park, PA; American Chemical Society (1972). 83p. (CONF-720485-). $2.00.

Reprints of nine papers from the Symposium on Modern Methods of Fuel Analysis are presented. A separate abstract was prepared for one of the papers. (DHM)

For an abstract of an individual paper see: 23895.

Activation and Nuclear Reaction Procedures

Refer also to abstracts 24212 and 24363.

23893 ACTIVATION AND DECAY TABLES OF RADIOISOTOPES. Bujdoso, E.; Feher, I.; Kardos, G. New York; American Elsevier Publishing Company, Inc. (1973). 575p.

With increased use of radioisotopes in science and industry, the calculation of the activity of a sample irradiated by thermal neutrons and the rate of decay has become a routine task. This book facilitates such calculations by means of tables. The activation and decay data presented include half-lives and gamma-ray energies and intensities of 249 radioisotopes formed by the (n,γ) reaction on 173 stable isotopes of 80 elements. Explanations of the tables and examples of how to use them are included. (RWR)

23894 MERCURY CONTENT OF AUSTRIAN SOILS DETERMINED BY NEUTRON-ACTIVATION ANALYSIS. Wimmer, J.; Haunold, E. Bodenkultur; 24: No. 1, 25-30(1973). (In German).

The soil (0.5 g) was irradiated for 24 hr., in a rotating sealed silica ampoule, in a flux of $\approx 3 \times 10^{13}$ n/cm^2 · sec, "cooled" for 5 days, and then heated with Hg acetate (50 mg) and 6M-HNO_3 (50 ml). After evaporating to 10 ml, the residue was diluted with H_2O (50 ml), and the filtered solution was treated with citric acid and $La(NO_3)_3$ (to suppress interference); the pH was adjusted to 8 to 9 with aq. NH_3, then Hg^{2+} was reduced to Hg metal with ascorbic acid. After 2 hr., HNO_3 was added to dissolve coprecipitated hydroxides, and the Hg was collected on a membrane-filter and dissolved in HNO_3 for measurement of ^{197}Hg. The chemical yield ranged from 75 to 90%. (Anal. Abstr.)

23895 EVALUATION OF THREE NEUTRON ACTIVATION ANALYSIS METHODS FOR MERCURY IN COAL. Weaver, J. N. (North Carolina State Univ., Raleigh); von Lehmden, D. J. pp 16-28 of Symposium on Modern Methods of Fuel Analysis. University Park, PA; American Chemical Society (1972).

From symposium on modern methods of fuel analysis; Boston, Massachusetts, USA (10 Apr 1972). See CONF-720485-.

An evaluation of three NAA techniques for mercury analysis in coal has been presented with special emphasis given to the use of a 16 mm Low Energy Photon Ge(Li) Detector for rapid instrumental NAA. Preliminary results show the possibility that many other elements with nuclides having low energy x-rays can easily be analyzed in coal using the LEPD gamma detector. (auth)

23896 APPLICATIONS OF NEUTRON ACTIVATION ANALYSIS TO ENVIRONMENTAL AND BIOMEDICAL STUDIES. Lukens, H. R.; John, J. (Gulf Energy and Environmental System, San Diego, CA). Advan. X-Ray Anal.; 16: 10-18(1973).

From applications of x-ray analysis conference; Denver, Colorado, USA (2 Aug 1972). See CONF-720801-.

The neutron activation analysis method and its attributes are discussed. Applications of this method in environmental and biomedical studies are given. (LK)

23897 PHOTOEFFICIENCY OF GAMMA-RADIATION RECORDING AND LIMITS OF DETECTION FOR INDIVIDUAL ELEMENTS IN ACTIVATION ANALYSIS USING Ge(Li) SEMICONDUCTOR DETECTORS. Pelekis, L. L.; Pelekis, Z. E.; Taure, I. Y. (Inst. of Physics, Riga). J. Radioanal. Chem.; 15: No. 2, 497-507(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The photoefficiency and source utilization coefficients for 3.5-, 28-, and 45-cm^3 Ge(Li) detectors were determined. Values of the source utilization coefficient were obtained as a function of the measurement geometry. Limits of detection were determined for 30 elements with long-lived isotopes and 38 elements with short-lived isotopes. (auth)

23898 OVERALL INSTRUMENTAL THERMAL NEUTRON ACTIVATION ANALYSIS OF HIGH-PURITY MATERIALS. Verheijke, M. L.; Verplanke, J. C. (Philips Research Labs., Eindhoven, Netherlands). J. Radioanal. Chem.; 15: No. 2, 509-515 (1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A more or less routine method for the determination of up to 55 trace elements down to the ppb range is described. To obtain this, irradiation in a high thermal neutron flux, followed by Ge(Li) γ-spectrometry with large detectors and off-line computerized evaluation of the spectra, is necessary. To cover the range of half-lives of the nuclides formed, spectrum measurements are carried out about one hour, one day, one week and one month after irradiation. Only in the case of highly active and rather long-living matrices is chemical separation of the matrix from all impurities necessary. The computer program is written in ALGOL-60. (auth)

23899 ACTIVATION ANALYSIS BY MEANS OF RESONANCE NEUTRONS AND POLARIZED PARTICLES. Shtan, A. S. (Atomic Energy Commission, Moscow). J. Radioanal. Chem.; 15: No. 2, 517-534(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The fundamentals of neutron resonance analysis (NRA) are briefly discussed, and results demonstrating increased selectivity obtained by means of NRA are presented. Three variations of NRA are described, namely activation, absorption, and spectral resonance methods of the slowing down time of neutrons based on the absorption and time selection of neutrons with defined energies. The potentialities of utilizing polarized neutrons for elemental analysis are discussed. (auth)

23900 THERMAL AND EPITHERMAL NEUTRON ACTIVATION ANALYSIS USING THE MONOSTANDARD METHOD. Alian, A.; Born, H. J.; Kim, J. I. (Technische Univ., Munich). J. Radioanal. Chem.; 15: No. 2, 535-546(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A new approach is presented for neutron activation analysis using the monostandard (single comparator) method. Elements to be determined are classified into two groups; those with $\sigma_0 > I_0$ are activated with whole neutron spectrum (without Cd-cover), using a standard of the same group (e.g., Sc), while elements with $I_0 > \sigma_0$ are activated with epithermal neutrons (under Cd-cover) using a standard of the same group (e.g., Au or Co). Epithermal activation increases the number of determinable elements and its coupling with the monostandard method has the advantage of using a small Cd-cover. The σ_0 and I_0 values of some elements were determined to test this approach. (auth)

23901 ACTIVATION ANALYSIS OF HIGH-PURITY SUBSTANCES BY MEANS OF SHORT-LIVED ISOTOPES. Lobanov, E. M.; Dutov, A. G.; Leushkina, G. V. (Atomic Energy Commission, Moscow). J. Radioanal. Chem.; 15: No. 2, 547-556(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A nondestructive activation analysis method intended for industrial utilization is described, using isotopes with half-lives from 2 sec to 20 min. Expected sensitivity values for 33 elements are listed. The effects on the results of neutron flux variation and other errors of measurement are discussed. Requirements to be met by the electronic spectrometer apparatus are stated. (auth)

23902 BETA-GAMMA-COINCIDENCE SPECTROSCOPY OF RADIOCHEMICAL SEPARATED NUCLIDES IN HIGH-SENSITIVITY NEUTRON ACTIVATION ANALYSIS. Niese, S. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). J. Radioanal. Chem.; 15: No. 2, 567-574(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Beta-gamma coincidence spectroscopy is a sensitive measurement technique in reactor neutron activation analysis. A simple counting device with a 4″ × 3″ NaI(Tl) crystal and a 32 mm × 2 mm plastic scintillator is described and the advantage of the β-γ coincidence technique, which has been successfully applied to the determination of iron and other impurities (Cu, Ag, Mn, Au) in semiconductor silicon, is discussed. (auth)

23903 ACTIVATION ANALYSIS WITH FAST NEUTRONS USING A CYCLOTRON. Krivan, V. (Max-Planck-Institut fuer Metallforschung, Schwaebisch Gmuend, Ger.); Muenzel, H. J. Radioanal. Chem.; 15: No. 2, 575-583(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A systematic study of activation analysis with cyclotron-produced neutrons for (n, 2n), (n, p), and (n, α) reactions is presented. The limits of detection for elements of atomic number from 6 to 80 are given. The possibilities of optimization of irradiation conditions by the choice of the most suitable neutron spectrum are discussed. The potential of this fast neutron activation analysis method is compared with that of 14-MeV neutron activation analysis. (auth)

23904 EXPERIMENT ON THE MEASUREMENT OF THE THICKNESS OF OXIDE LAYERS BY IRRADIATION WITH 14-MeV NEUTRONS. Dugain, F.; Michaut, C. (Centre de Recherches, Voreppe, France). J. Radioanal. Chem.; 15: No. 2, 585-590 (1973). (In French).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

It is shown that the surface oxygen content of thin aluminum foils can be found using 14-MeV neutron activation. The results obtained with this method are in good agreement with those given by ellipsometric methods for oxide layers from 50 to 500 Å. (auth)

23905 IN SITU ACTIVATION ANALYSIS OF MARINE SEDIMENTS WITH ^{252}Cf. Wogman, N. A.; Rieck, H. G. Jr.; Kosorok, J. R.; Perkins, R. W. (Battelle Pacific Northwest Labs., Richland, Washington). J. Radioanal. Chem.; 15: No. 2, 591-600(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A seabed nuclear probe has been developed which permits the measurement of up to 33 elements at the parts per thousand to parts per million levels in continental shelf areas. The probe consists of a neutron irradiation source, ^{252}Cf, which neutron activates the elements in the minerals of interest. These resulting radioactive elements emit characteristic gamma radiation which is analyzed in situ in 2- to 10-min counting intervals with a Ge(Li) detector system. Details of the irradiation source, the Ge(Li) detector, and spectra taken in situ in a marine environment are discussed with respect to the detection of the minerals at concentrations of economic interest. (auth)

23906 APPLICATION OF NEUTRON ACTIVATION ANALYSIS TO THE MEASUREMENT OF ISOTOPE ABUNDANCE SHIFTS IN CALCIUM AND POTASSIUM. Moeller, P.; Sastri, C. S. (Hahn-Meitner Inst., Berlin). J. Radioanal. Chem.; 15: No. 2, 615-625 (1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A simple method for the measurement by neutron activation analysis of the isotopic abundance shifts of ^{44}Ca and ^{41}K in compounds of low volatility is described. Extraction and measurement procedures for the radioactive argon isotopes (^{37}Ar, ^{39}Ar and ^{41}Ar) produced by (n, α) and (n, p) reactions are also given. The results obtained demonstrate that the accuracy for the measurement of δ^{44}Ca is better than by the mass spectrometric method; in the case of δ^{41}K measurement the accuracy is the same as that obtained with the mass spectrometer. Interfering reactions which yield other rare gases, and their relative contribution to the error in the measurement of δ values are also discussed. (auth)

23907 USE OF DATA PROCESSING TO ESTABLISH INSTRUMENTAL MULTI-ELEMENT ACTIVATION ANALYSIS AS A ROUTINE METHOD. Gierl, A. (Univ., Munich). J. Radioanal. Chem.; 15: No. 2, 627-635(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A computer program has been worked out for the following requirements: (1) The program is to render a listing of the elements detected, together with their respective concentrations, not just an evaluation of the gamma spectrum (peak energies and areas). (2) There should be no necessity to intermediate decisions (i.e., execution of the program should be possible by auxiliary personnel). (3) Gamma spectra recorded under widely different conditions should be amenable to evaluation. This implies a large range of variation of the number of channels per peak. (4) In order to have the most extensive capability of executing multielement analyses instrumentally, it must be possible to evaluate complex spectra with many superpositions. The program involves the fitting of Gaussians. It is shown that this evaluation method gives more precise peak area determinations than the summation method and also yields reasonable results in the case of strong superposition. (auth)

23908 COMPARATIVE ANALYSIS OF DIFFERENT COMPUTER HANDLING SYSTEMS FOR GAMMA-SPECTROMETRIC DATA DEVELOPED AT C.C.R. ISPRA. Bertozzi, G.; Girardi, F.; Guzzi, G.; Di Cola, G. (Joint Nuclear Research Center, Ispra, Italy). J. Radioanal. Chem.; 15: No. 2, 637-646(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Three different computer systems for gamma-spectrometric data-handling have been developed at the Joint Nuclear Research Center of Ispra. The systems are: (1) batchwise treatment of the data with a large computer, (2) time-shared teleprocessing by means of a centralized computer, and (3) use of a small computer at the laboratory site. The paper describes both hardware and software of the three systems with emphasis on their practical use and on advantages and disadvantages in routine application. A partial analysis of the running costs of the systems is also presented. (auth)

23909 LABORATORY-BASED MULTI-INSTRUMENT COMPUTER SYSTEM. DeVoe, J. R. (National Bureau of Standards, Washington, DC). J. Radioanal. Chem.; 15: No. 2, 657-667(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Design of computer system for assistance in the operation of experiments contains certain factors unique to a particular laboratory. Details are given on the procedure that was used to generate design criteria and to implement such a design for a computer system in the Analytical Chemistry Division, NBS. The system is currently servicing ten instruments (ranging from spectrophotometers to mass spectrometers) with a projected capacity exceeding sixty depending upon the type of instruments connected. (auth)

23910 QUALITATIVE AND QUANTITATIVE INTERPRETATION OF GAMMA-RAY SPECTRA IN ACTIVATION ANALYSIS. Korthoven, P. J. M. (Interuniversitair Reactor Instituut, Delft, Netherlands). J. Radioanal. Chem.; 15: No. 2, 675-682(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A method is presented for the automatic identification of the elements present in a sample and the calculation of the corresponding concentrations from the energies and peak areas determined by a spectrum analysis computer program. A preliminary interpretation list is produced in which the possible isotopes are given for each peak in the spectrum. This list is based only on the gamma energies and half-lives of the isotopes. A careful analysis of this list yields groups of identified elements at four different significance levels. The determination of the corresponding concentrations is based on the single-comparator method. The procedure is included in an automatic activation analysis system but can also be used separately. (auth)

23911 ANALYSIS OF PRECISION OF ACTIVATION ANALYSIS METHOD. Heydorn, K.; Norgard, K. (Danish Atomic Energy Commission Research Establishment, Riso). J. Radioanal. Chem.; 15: No. 2, 683-693(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The precision of an activation analysis method prescribes the estimation of the precision of a single analytical result. The adequacy of these estimates to account for the observed variation between duplicate results from the analysis of different samples and materials is tested by the statistic T, which is shown to be approximated by a chi-squared distribution. Application of this test to the results of determinations of manganese in human serum by a method of established precision, led to the detection of airborne pollution of the serum during the sampling process. The subsequent improvement in sampling conditions was shown to give not only increased precision, but also improved accuracy of the results. (auth)

23912 INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS LIMITS OF DETECTION IN THE PRESENCE OF INTERFERENCES. Guinn, V. P. (Univ. of California, Irvine). J. Radioanal. Chem.; 15: No. 2, 473-477(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Many tables of neutron activation analysis (NAA) limits of detection, in the absence of interferences, for various irradiation and counting conditions, may be found in the literature. This paper presents a method for estimating, in advance, the instrumental NAA limits of detection for any elements of interest in any given matrix, including ones generating high interference levels. The rationale of the method is presented, and the procedure for applying it is illustrated. (auth)

23913 CALCULATION OF OPTIMAL CONDITIONS IN ACTIVATION ANALYSIS. Fedoroff, M. (CECM, Vitry, France). J. Radioanal. Chem.; 15: No. 2, 435-449(1973). (In French).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The calculation concerns the following three parameters; the duration of irradiation, time elapsed between the end of the irradiation and the radioactivity measurement, and duration of the activity measurement. The calculation is carried out in two different ways thus either sensitivity or maximum precision can be obtained. The optimum values of the studied variables are plotted against the simple parameter in the cases when the ground noise is produced by a single component and the radioactivity originates from one isotope. The values of the variables corresponding to the optimum, about 10% precision and sensitivity, are also given. These values make possible to reduce significantly the time required for the analysis. (auth)

23914 APPLICATION OF COMPUTERS FOR THE SELECTION OF THE OPTIMUM METHOD AND FOR AUTOMATED DATA-PROCESSING IN INSTRUMENTAL ACTIVATION ANALYSIS. Ivanov, I. N. (Atomic Energy Commission, Moscow). J. Radioanal. Chem.; 15: No. 2, 451-465(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Prospects of the application of computers for the selection of optimum methods and for data-processing in activation analysis are discussed. Programs were developed to select the irradiation source and the type of recording apparatus and to optimize time conditions. Various methods for handling gamma spectra are discussed. Complex utilization of the programs allows in many cases the elimination of the necessity of developing individual procedures, and the determination of the optimum method for a given element and given analysis parameter. (auth)

23915 ULTIMATE CONTRIBUTION OF NUCLEAR ACTIVATION TO ANALYSIS. Meinke, W. W. (National Bureau of Standards, Washington, DC). J. Radioanal. Chem.; 15: No. 2, 419-433(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The objective in analysis, accuracy through Standard Reference Materials, present state of trace analysis, present state of activation analysis, and the challenge for the future are considered in this plenary lecture. (LK)

23916 METHOD FOR MEASUREMENT OF THE HALF-LIFE OF A RADIOACTIVE MATERIAL AND APPLICATIONS. Beeler, R.; Balsenc, L.; Laplace, J. (Univ., Geneva). J. Radioanal. Chem.; 15: No. 2, 489-496(1973). (In French).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A function describing a curve taken on a multiple-stage instrument is proposed. This function depends on three parameters: time, half-life, and initial dead-time. The latter has been measured accurately on an electronic unit developed for this purpose. The half-lives of certain elements (Hf, Ag, Se, Na, V, Sc, Al) have been determined, and the differences in the half-lives of an element and its salt have been pointed out. (2 figures, 2 tables) (auth)

23917 USE OF A HIGH EFFICIENCY MASS SEPARATOR IN ACTIVATION ANALYSIS. Rook, H. L.; Lutz, G. J.; LaFleur, P. D. (National Bureau of Standards, Washington, DC). J. Radioanal. Chem.; 15: No. 2, 557-566(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The application of high yield mass separators to problems in activation analysis is discussed. The identification of separation parameters including separator yields, memory, resolution and overlap, and sputtering are considered. The use of the mass separator in determining lead by photon activation analysis is described. (auth)

23918 DETERMINATION OF THE TUNGSTEN CONTENT IN ORES AND ORE-PROCESSING PRODUCTS BY THE (γ,γ') REACTION. Kodiri, S.; Abrams, I. A.; Pelekis, L. L.; Starchik, L. P. Ind. Lab. (USSR) (Engl. Transl.); 39: No. 1, 60-61(Jan 1973).

Translated from Zavod. Lab.; 39: No. 1, 39-41(Jan 1973).

Tungsten content in ores and ore-processing products can be determined by the $^{182}W(\gamma,\gamma')^{183m}W$ reaction in the presence of any quantities of Mn, Fe, Zr, Cu, Ti, V, Mo, Sb, Tl, Ba, Ta, Nb, Pb, or other ingredients of the ores because the threshold of bremsstrahlung energy used does not induce activity in any of elements except barium. An optimally chosen irradiation time can reduce the influence of ^{137m}Ba to a negligible level. (LK)

23919 NEUTRON ACTIVATION METHOD FOR THE DETERMINATION OF MICROAMOUNTS OF OXYGEN IN TITANIUM SPONGE. Galkin, R. M. (Bereznik Titanium–Magnesium Combine, USSR). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 2, 345-346(Feb 1973).

Translated from Zavod. Lab.; 39: No. 2, 244-245(Feb 1973).

Oxygen in titanium sponge is determined by the $^{16}O(n,p)^{16}N$ reaction. The sensitivity of the neutron activation method is calculated by the formula $m = [MA/f\sigma\theta(6.02 \times 10^{23})]$, where m is the minimum amount of the element being assayed, g; M is the atomic weight of the element being assayed; A is the minimum activity of the element being assayed, dis/min; f is the neutron flux, $n/cm^2 \cdot sec$; σ is the activation cross-section for the given reaction, cm^2; and θ is the fractional abundance of the isotope undergoing the nuclear reaction in a natural isotopic mixture of the element being irradiated. (LK)

23920* DETERMINATION OF COPPER IN COPPER-CONCENTRATE PULP AND ORES BY THE METHOD OF NEUTRON ACTIVATION. Velyus, L. M.; Fomenko, V. T.; Fomenko, I. N. (Magnitogorsk Mining-Metallurgical Inst., USSR). Ind. Lab. (USSR) (Engl. Transl.); 38: No. 12, 1882-1884(Dec 1972).

Translated from Zavod. Lab.; 38: No. 12, 1490-1492(Dec 1972).

With a suitable choice of neutron source, activation analysis of copper in copper concentrate pulp and ores having a small copper content satisfies the requirements for simplicity, speed, and accuracy. (LK)

Chemical and Spectral Procedures

Refer also to abstracts 24182 and 26502.

23921 OPTIMAL CONDITIONS FOR IODINE DETERMINATION BY A NEW VARIANT OF THE KINETIC NITRITE–THIOCYANATE METHOD. Shveikina, R. V. J. Appl. Chem. USSR (Engl. Transl.); 46: No. 8, 1948-1952(Aug 1973).

Translated from Zh. Prikl. Khim.; 46: No. 8, 1836-1838 (Aug 1973).

Sulfate and cyanide ions and oxides of nitrogen are formed in the oxidation of thiocyanate ions by nitrite ions in the presence of nitrate ions. Since sulfate ions were found in the reaction products, a study was made of the conditions for determination of iodine by a kinetic method from the concentration of these ions. The following equation can be used for calculating reagent concentrations, giving solutions of the optimal optical density: $y \cdot 10^2 = -346.7 + 61C_{HNO_3} + 11.6C_{NaNO_3} + 6.1C_{KCNS}$. (LK)

23922 DETERMINATION OF DISSOLVED OXYGEN IN WATER. Bibliographical Review. Masson, J. P. (CEN de Saclay, Gif-sur-Yvette, France). Analusis; 2: No. 8, 608-618(Sep 1973). (In French).

The increasing importance assumed, in various fields of chemistry, by the determination of dissolved oxygen in water is pointed out. Some numerical data concerning this solubility are presented. The diverse titration procedures in general use are described: volumetry, absorptiometry, amperometry, coulometry, conductometry, and radiometric and chromatographic methods. For each of these, the principle involved, the experimental conditions, the available concentration range, and the performance are discussed in such a way as to facilitate the evaluation of the scope of the methods. (FR)

23923 DIRECT ANALYSIS FOR OXYGEN-18 IN GLUCOSE BY MASS SPECTROMETRY. Caprioli, R. M.; Seifert, W. E. Jr. (Purdue Univ., West Lafayette, IN). Biochim. Biophys. Acta; 297: No. 2, 213-219(1973).

It is shown that both the position and the content of ^{18}O in D-glucose can be established by m.s. of the penta-acetyl derivative. Details are given of the preparation of pentaacetylated hexoses enriched in ^{18}O at the 1-, 2-, 3- or 6-positions for use as standards in elucidating the fragmentation patterns. It was possible to identify fragmentation ions containing specific O atoms of glucose, thus permitting measurement of ^{18}O incorporated at these positions. An example is given of the use of the technique for studying [4-^{18}O]glucose prepared by an enzymic reaction. (Anal. Abstr.)

23924 FLUORESCENCE REACTION OF SCANDIUM WITH 5-HYDROXYCHROMONE AND ITS DERIVATIVES. Nakamura, M.; Murata, A. (Shizuoka Univ., Hamamatsu, Japan). Jap. Anal.; 22: No. 11, 1474-1480(Nov 1973). (In Japanese).

Scandium forms yellow complexes with 5-hydroxychromone and its derivatives, which are extracted into various organic solvents. These complexes exhibit yellow-green fluorescence which is the most intense and constant when extracted from a solution of pH > 11.0. The substituent effect of alkyl, acetyl and methoxyl groups on the fluorescence behavior was studied and compared with that in the case of beryllium complexes previously reported. Furthermore, the fluorometric determination of scandium was attempted. The substituent effect was similar to that on the beryllium complexes. The maximum wavelengths of absorption, excitation, and emission spectra were nearly 395, 400, and 505 nm, respectively, except those of the complex of 2-methyl-7-methoxy derivative, which were shifted to shorter wavelengths. The relative fluorescence intensities in benzene were increased by the introduction of alkyl group into the 2- and 3-positions, especially the 2-position, of 5-hydroxychromone. The fluorescence intensities of 2,3-dialkyl derivatives were about 14 to 15 times that of 5-hydroxychromone. Introduction of an acetyl group into the 3-position decreased the intensity. Methoxyl group in the 7-position increased the intensity. Only the effect of methoxyl group in the 7-position was different from that observed with beryllium complex. Among the derivatives examined, 2-ethyl-3-methyl-5-hydroxychromone was the most suitable reagent for the fluorometric determination of scandium, since the fluorescence of its complex was one of the most intense and stable. As an extraction solvent benzene is useful because of high stability of the complex in it. The calibration curve is linear up to 4.0 μg of scandium. The effects of diverse ions were examined. (auth)

23925 DIRECT TITRIMETRIC MICRO-DETERMINATION OF URANIUM(VI) AND OF L-ASPARAGINE. Rai, S. J.; Gupta, P. C.; Saxena, O. C. (Univ. of Allahabad, India). Microchem. J.; 18: No. 3, 262-266(1973).

The method is based on the reaction of $UO_2(NO_3)_2$ and asparagine to form a 1:2 complex. The U was determined by titration with 0.024M-L-asparagine (Congo red as indicator); conversely, L-asparagine could be determined by titration with 0.033M-$UO_2(NO_3)_2$ (gallocyanine or Congo red as indicator). The maximum error was 0.8% for 1.6 to 40 μg of U per liter and 1.6% for 1.8 to 18 μg of asparagine per liter. Certain metals (listed) interfere in the determination of U. (Anal. Abstr.)

23926 AMPEROMETRIC DETERMINATION OF YTTRIUM, IRON, AND MAGNESIUM IN PREPARED MIXTURES BY COMPLEXOMETRIC TITRATION. Zhdanov, A. K.; Markhabaev, I. A. (Tashkent State Univ.). Zh. Vses. Khim. Obshchest. im. D. I. Mendeleeva; 18: No. 3, 350-351(1973). (In Russian).

Consecutive titrations with EDTA are carried out with use of a tantalum electrode vs. a S.C.E. Procedure: Titrate the Fe at pH 2.0, with HNO_3 as basal electrolyte and with the tantalum electrode maintained at 1.2 V (under these conditions Y does not form a complex with EDTA). Adjust the pH to 4.5 to 5.0 by adding Na acetate, decrease the electrode potential to 1.1 V, and titrate the Y. Then add an ammoniacal buffer solution, adjust the electrode potential to 0.9 V, and titrate the Mg. Statistical treatment showed the results to be of satisfactory accuracy. (Anal. Abstr.)

23927 GRAVIMETRIC DETERMINATION OF URANIUM(VI) WITH PYRIDINE-2,6-DICARBOXYLIC ACID. Marangoni, G.; Degetto, S.; Croatto, U. (Consiglio Nazionale delle Recherche, Padua). Talanta; 20: No. 11, 1217-1220(Nov 1973).

Uranium (VI) can be quantitatively precipitated from aqueous solution in the pH range 2.1 to 6.9 with pyridine-2,6-dicarboxylic acid in the presence of tetraphenylarsonium chloride. This provides a new rapid gravimetric method for uranyl ion as an organic chelate complex of high molecular weight. Sodium, aluminium, copper, and nickel as well as nitrate, chloride, sulfate and acetate ions, do not interfere, but iron(III) and thorium(IV) do. (auth)

23928 DETERMINATION OF VANADIUM AND MOLYBDENUM BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY. Korkisch, J.; Gross, H. (Univ., Vienna). Talanta; 20: No. 11, 1153-1165 (Nov 1973).

A method is described for the determination by atomic-absorption spectrophotometry of vanadium and molybdenum, up to the milligram level, in samples of yellow cake, uranium-bearing minerals, and geochemical standards. After attack with acids these two elements are separated from each other and from matrix elements by means of anion-exchange in 6M hydrochloric acid on the strongly basic anion-exchange resin Dowex 1, X8 (chloride form). Vanadium is unadsorbed and passes into the effluent while molybdenum is adsorbed on the resin. For the elution of molybdenum a mixed aqueous-organic solvent system consisting of methanol and 6M hydrochloric acid (9:1 v/v) is used. After evaporation of the 6M hydrochloric acid effluent and of the mixed aqueous-organic eluate, vanadium and molybdenum are determined by atomic-absorption spectrophotometry. The method was tested by analyzing numerous samples with contents ranging from a few ppM to milligram amounts of vanadium and molybdenum. For comparison, the concentrations of these two elements were determined in a large number of samples by spectrophotometric and titrimetric procedures. In all cases very good agreement of results was obtained. (auth)

23929 SPECTROPHOTOMETRIC DETERMINATION OF MOLYBDENUM BY EXTRACTION OF A GREEN MOLYBDENUM(V) SPECIES. Yatirajam, V.; Ram, J. (Kurukshetra Univ., India). Talanta; 20: No. 11, 1207-1210(Nov 1973).

A simple method is described for the rapid spectrophotometric determination of molybdenum in samples containing 1 to 60% Mo, with satisfactory accuracy. Molybdenum is reduced with excess of hydrazine sulfate in boiling 5.5M hydrochloric acid and extracted with isoamyl acetate from 7M hydrochloric acid. The green color is measured at 720 nm against a reagent blank. Beer's law is obeyed over the range 0.08 to 5.4 mg of molybdenum per ml. Interference from iron and copper is removed by adding stannous chloride and thiourea respectively in slight excess. Titanium, vanadium, niobium, chromium, tungsten, nickel, uranium, and antimony do not interfere even in large amounts. Only cobalt interferes seriously. (auth)

23930 ANION-EXCHANGE SEPARATION AND SPECTROPHOTOMETRIC DETERMINATION OF THORIUM IN GEOLOGICAL SAMPLES. Korkisch, J.; Dimitriadis, D. (Univ., Vienna). Talanta; 20: No. 11, 1199-1205(Nov 1973).

To determine thorium in geological samples it is first separated from all matrix elements by means of anion-exchange. After elution thorium is determined spectrophotometrically by using thoronol or arsenazo III. The suitability of the method for the determination of both trace and larger amounts of thorium was tested by analyzing numerous geochemical standard samples with thorium contents in the range of 1 to 1000 ppM. In all cases very good agreement was obtained. (auth)

23931 AMPEROMETRIC TITRATION OF NIOBIUM. Marchidan, S. (Centrul de Chimie Fizica, Bucharest). Stud. Cercet. Chim.; 21: No. 12, 1419-1429(Dec 1973). (In Rumanian).

Data on the amperometric titration of Nb are compiled and analyzed. Polarographically active organic reagents capable of reacting quantitatively with Nb are described. For each reagent some details are given of its reactivity, proportionality range, potential, composition, and interferences in analytical applications. Amperometric titration is suitable for the microquantitative determination of Nb in various materials. (tr-auth)

23932 SPECTROPHOTOMETRY OF THE SYSTEM ARSENAZO III–URANIUM(VI). I. Preliminary Study in Aqueous and Aqueous-Organic Chloracetic Acid-Chloroacetate Media. Perez-Bustamante, J. A.; Palomares Delgado, F. (Ciudad Univ., Madrid). Inform. Quim. Anal., Pura Apl. Ind.; 27: No. 3, 119-137(1973). (In Spanish).

For the determination of U(VI) in aqueous media as its 1 : 1 complex with arsenazo III, the test solution, containing 5 to 50 μg of U(VI), is treated with 10.6M-chloroacetic acid (0.7 ml), 5M-NaOH (0.75 ml), $HClO_4$ (1 : 5) (1.25 ml), and 0.1% aqueous arsenazo III (1.5 ml) and the solution is diluted to 10 ml with H_2O; the pH should be 1.75 ± 0.25. After 1.5 hr., the extinction is measured at 655 nm, and the U(VI) content is found from a calibration graph. The complex is rather weak and shows a high degree of dissociation. Numerous cations interfere, and preliminary solvent extraction of the U(VI) may be necessary. A preliminary study has been made of the determination of U(VI) in mixed media such as would arise by admixture of an organic solution, containing extracted U(VI), with an aqueous solution of arsenazo III. (Anal. Abstr.)

23933 VARIATION IN THE NATURAL NITROGEN-15 ABUNDANCE IN NITRATE MINERALIZED DURING INCUBATION OF SEVERAL ILLINOIS SOILS. Feigin, A.; Kohl, D. H.; Shearer, G.; Commoner, B. (Washington Univ., St. Louis). Soil Sci. Soc. Amer., Proc.; 38: No. 1, 90-95(1974).

Samples of the surface layer of soil (0-30 cm) were collected from five sites in central Illinois. The soils were incubated under controlled conditions for an extended period of time in an effort to determine the $^{15}N/^{14}N$ ratio of the mineralizable nitrogen. The results show that the $^{15}N/^{14}N$ ratio of the nitrate released from the soils tested was approximately constant with time of incubation after about 5 weeks. During the first weeks of incubation, the $^{15}N/^{14}N$ ratio of the nitrate released increased from an initially low value in four of the five soils tested. The constant values of $\delta^{15}N$ (per mill enrichment) for these soils were about +7.6 to +10. It was concluded that these values represent the ^{15}N enrichment of the mineralizable pool of organic N in these soils, which include major soil associations of the central Illinois Corn Belt. (auth)

23934 SPECTROPHOTOMETRIC DETERMINATION OF URANIUM WITH THE SODIUM SALT OF 1-PHENYL-3-(4-SULPHOPHENYL)PROPANE-1,3-DIONE [4-(1,3-DIOXO-3-PHENYLPROPYL)-BENZENESULPHONIC ACID]. Troeltzsch, C.; Reinbothe, R. (Arndt Univ., Greifswald, Ger.). Z. Chem.; 13: No. 6, 228-229(1973). (In German).

Treat the sample (containing 1.9 to 19μg of UO_2^{2+} per ml) with imidazole (I) buffer solution (10 ml). Add a 4 mM solution of the title compound (10 ml) and dilute to 50 ml. Record the extinction at 397.5 nm in 5-mm cells against a reagent blank. Determine the UO_2^{2+} content of the sample by reference to a calibration graph. Interference from Al, Mg, Zn, Cu, Ni, Co, Mn (10 μg of each) and Fe^{3+} (200 μg) can be overcome by adding 0.1% aqueous NaCN (2 ml) and 0.01M-EDTA (2 ml) before dilution to volume, but a separate calibration graph is then necessary as the color intensity is slightly reduced. (Anal. Abstr.)

23935 DETERMINATION OF FLUORIDE IN PUREX PROCESS SOLUTIONS. Ertel, D.; Knittel, G.; Herling, I. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Anal. Chem.; 28: No. 1, 26-28 (Jan 1974). (In German).

The fluoride content of aqueous and organic Purex process solutions can be determined with good reproducibility and accuracy. The method includes a distillation separation of fluoride and its subsequent electrometric determination using a fluoride-selective electrode. The analytical range covers 5 to 500 μg of fluoride per aliquot and the concentration limit is 5×10^{-5} M (1 ppM). Complexing cations such as Al(III), Zr(IV), La(III), and U(VI) do not interfere. (GE)

23936 SPECTRAL DETERMINATION OF TANTALUM AND TUNGSTEN IN A GALLIUM-BASED ALLOY. Miskar'yants, V. G.; Nikitina, L. A. Ind. Lab. (USSR) (Engl. Transl.); 38: No. 12, 1855-1856(Dec 1972).

Translated from Zavod. Lab.; 38: No. 12, 1467-1469(Dec 1972).

Tantalum and tungsten were determined in gallium–indium–tin alloy by direct spectral analysis. Addition of Teflon caused the tantalum and tungsten to volatilize in the first 30-sec burning of the arc; the gallium base had not volatilized completely after 5 min. Spectra were recorded in the first 30-sec exposure when the ratio of the line to the background is at its highest. (LK)

23937 SPECTROGRAPHIC DETERMINATION OF RARE-EARTH ELEMENTS IN SOLUTIONS IN THE PRESENCE OF ALUMINUM AND IRON. Fadeeva, L. A.; Karpenko, L. I.; Bel'tyukova, S. V. (Inst. of General and Inorganic Chemistry, Odessa). Ind. Lab. (USSR) (Engl. Transl.); 38: No. 12, 1852-1854(Dec 1972).

Translated from Zavod. Lab.; 38: No. 12, 1464-1467(Dec 1972).

The effect of aluminum and iron on the spectrographic determination of rare earth elements in solution was studied. Investigations into the primary processes (delivery of the analyzed material to the discharge zone) showed that with aluminum and iron concentrations of 10-20 mg/ml the amount of solution delivered into the discharge zone decreases by a factor of 2 to 2.5 compared with the analysis of samples not containing aluminum and iron. Reduction of the amount of substance delivered into the discharge leads to weakening of the spectra, which affects the sensitivity of the determination of the rare earth element. (LK)

23938 DETERMINATION OF SMALL AMOUNTS OF ZIRCONIUM IN ALLOY STEELS. Busev, A. I.; Kharlamov, I. P.; Byzova, E. P. Ind. Lab. (USSR) (Engl. Transl.); 38: No. 12, 1816-1818(Dec 1972).

Translated from Zavod. Lab.; 38: No. 12, 1433-1435(Dec 1972).

Optimum conditions were determined for the extraction of microgram quantities of zirconium with chloroform as the thiocyanate-diantipyrimethane complex and reextraction of the zirconium from the organic phase. The effect was studied of the ions of impurities on the extraction of zirconium with subsequent determination of that element using Arsenazo III in the reextraction. (LK)

23939 INVESTIGATION OF THE CONDITIONS OF EXTRACTION-SPECTROPHOTOMETRIC DETERMINATION OF NIOBIUM WITH SODIUM PYRROLIDINEDITHIOCARBAMINATE. Uvarova, K. A.; Usatenko, Yu. I.; Klopova, Zh. G. (Donets Polytechnical Inst., USSR). Ind. Lab. (USSR) (Engl. Transl.); 38: No. 12, 1813-1815(Dec 1972).

Translated from Zavod. Lab.; 38: No. 12, 1431-1433(Dec 1972).

The interaction of niobium with sodium pyrrolidinedithiocarbaminate in the presence of ClO_4^- ions leads to formation of a colored dithiocarbaminate in a broad interval of acidity. This interaction is the basis of an extraction-spectrophotometric determination of niobium. (LK)

23940 STUDY OF CONDITIONS OF THE EXTRACTION-PHOTOMETRIC DETERMINATION OF NIOBIUM AS THE TRIHYDROXYFLUORONATE. Nazarenko, V. A.; Yagnyatinskaya, G. Ya. (Inst. of General and Inorganic Chemistry, Kiev). Ind. Lab. (USSR) (Engl. Transl.); 38: No. 12, 1809-1812(Dec 1972).

Translated from Zavod. Lab.; 38: No. 12, 1427-1430(Dec 1972).

Microimpurities of niobium in pure titanium and titanium compounds were determined by a combination of extraction of niobium with a chloroform solution of tribenzylamine and the extraction of its trihydrofluorone complex. (LK)

23941 SPECTROPHOTOMETRIC DETERMINATION OF ELEMENTS OF THE YTTRIUM SUBGROUP IN SOME MINERAL WATERS. Kirillov, A. I.; Makarenko, O. P.; Vlasov, N. A. (Irkutsk State Univ., USSR). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 1, 1-3(Jan 1973).

Translated from Zavod. Lab.; 39: No. 1, 1-3(Jan 1973).

A spectrophotometric method using pyrocatechol violet (PCV) and boric acid was developed for determination of elements of the yttrium subgroup in mineral waters. Lanthanum and yttrium form blue complexes with PCV at pH 8.4 to 9.0 with a light absorption maximum at 665 nm. At this pH PCV is also blue and absorbs at the same spectral region. Boric acid is used in a 200- to 250-fold excess to tie up the PCV in a yellow boropyrocatechol violet complex that absorbs at 500 nm. Use of boric acid increases the sensitivity of the method. (LK)

23942 ION RECEIVER ON A MASS SPECTROMETER FOR PRECISION ISOTOPE ANALYSIS OF MOLECULAR OXYGEN OF NATURAL CONCENTRATIONS (EXCHANGE OF EXPERIENCE). Vetshtein, V. E. (Inst. of Physical Chemistry, Kiev). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 2, 336(Feb 1973).

Translated from Zavod. Lab.; 39: No. 2, 238(Feb 1973).

An ion receiver constructed for use on the MI-1305 mass spectrometer for precision recording of the ratio $^{18}O/^{16}O$ is described. The ion receiver permits simultaneous use of ions 34 and 32 amu. (LK)

23943 DETERMINATION OF SCANDIUM BY AN EMISSION FLAME PHOTOMETRIC METHOD (EXCHANGE OF EXPERIENCE). Kr[illegible]enko, S. V.; Shatskii, V. M.; Komissarova, L. N.; Kosolapova, N. Yu. (Moscow State Univ.). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 2, 240(Feb 1973).

Translated from Zavod. Lab.; 39: No. 2, 170-171(Feb 1973).

Determination of scandium in solutions of scandium chloride by emission flame photometry is described. The method is simple, rapid, and does not require separation of any of the elements that usually accompany scandium. Two-tenths milliliter of solution is required for the determination. (LK)

23944 DETERMINATION OF IMPURITIES IN RARE EARTH OXIDES BY THE ATOMIC ABSORPTION AND ATOMIC FLUORESCENCE METHODS USING PULSED VOLATILIZATION. Guzeev, I. D.; Blinova, E. S.; Maiorov, I. A.; Nedler, V. V. Ind. Lab. (USSR) (Engl. Transl.); 39: No. 2, 231-233(Feb 1973).

Translated from Zavod. Lab.; 39: No. 2, 165-167(Feb 1973).

A method for the atomic absorption and atomic fluorescence analysis of solid materials using pulsed volatilization is described. This method permits determination of Na, K, Mg, Ca, Cu, Mn, and Fe when present in amounts from 10^{-6} to 10^{-3}% in Y, La, Nd, Pr, and Tb oxides. Greater sensitivity is obtained using the atomic fluorescence method. (LK)

23945 COMPARISON OF METHODS OF DETERMINATION OF ALUMINUM IN BERYLLIUM AND ITS ALLOYS (EXCHANGE OF EXPERIENCE). Vinogradov, A. V.; Zemlyanukhina, N. A.; Pavlova, I. V.; Dronova, M. P.; Lopatina, N. N. Ind. Lab. (USSR) (Engl. Transl.); 39: No. 2, 199-200(Feb 1973).

Translated from Zavod. Lab.; 39: No. 2, 148-149(Feb 1973).

Four methods of determining 0.1–30% aluminum in beryllium and beryllium–aluminum alloys were compared: gravimetric method with hydroxyquinoline; gravimetric method with hydroxyquinoline from aqueous acetone medium; complexometric method by back titration with thorium; and photometrically with methylthymol blue. The most accurate method is the gravimetric hydroxyquinoline method, while the most rapid is the photometric method, which is applicable in the presence of many elements that give strong complexes with the complexone. (LK)

23946 FLUORESCENT DETERMINATION OF IMPURITIES OF ERBIUM, THULIUM, AND YTTERBIUM IN LANTHANUM OXIDE. Efryushina, N. P.; Smirdova, N. I.; Poluektov, N. S.; Kudryashov, V. A. (Inst. of General and Inorganic Chemistry, Odessa). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 2, 175-177 (Feb 1973).

Translated from Zavod. Lab.; 39: No. 2, 129-132(Feb 1973).

A method for determining Er, Tm, and Yb in La_2O_3 is described. The method is based on the fluorescence properties of activated LaOCl and the peculiarities of the interaction among the lanthanide ions. (LK)

23947 SPECTROPHOTOMETRIC DETERMINATION OF COBALT IN ALLOYS IN THE PRESENCE OF ELEMENTS OF THE CERIUM SUBGROUP (EXCHANGE OF EXPERIENCE). Batasheva, N. A.; Sivanova, O. V.; Gritsienko, N. N. (Saratov State Univ., USSR). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 1, 23-24(Jan 1973).

Translated from Zavod. Lab.; 39: No. 1, 17-18(Jan 1973).

A method based on complexing of the Co^{2+} with the reagent tetra[bis(4-sodiumtetrazolylazo-5-)ethyl acetate] was developed for determination of cobalt in alloys in the presence of cerium subgroup rare earths. (LK)

23948 GAS-CHROMATOGRAPHIC DETERMINATION OF OXYGEN AND NITROGEN IN HIGH-MELTING MATERIALS. Mikhailichenko, L. I.; Markov, V. K.; Dolgov, A. S.; Rudakova, T. V.; Kossykh, V. G. Ind. Lab. (USSR) (Engl. Transl.); 39: No. 1, 17-19(Jan 1973).

Translated from Zavod. Lab.; 39: No. 1, 13-15(Jan 1973).

Development of a rapid method for determination of oxygen and nitrogen in high-melting materials based on a pulse extraction method and chromatographic analysis of the evolved gases is reported. The materials used were W, Mo, Nb, Zr, Ti, steel, ZrU, ZrC, and NbC. (LK)

Radiometric and Radiochemical Procedures

Refer also to abstracts 24170, 24272, 24317, 24371, 24374–24378, and 24569.

23949 (LBL-2468) EVALUATION OF THE ERC VIRTUAL IMPACTOR. Loo, B. W.; Jaklevic, J. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1974. Contract W-7405-eng-48. 25p. Dep. NTIS $4.00.

Measurements have been made on a dichotomous virtual impactor developed by the Environmental Research Corporation. The object was to study the feasibility of employing the virtual impaction scheme in air samplers to collect size fractionated particle samples for subsequent x-ray fluorescence analysis. The size separation characteristics and losses as a function of particle size at specific locations within the apparatus were determined. It was found that except for the intrinsic losses near the size cut point, most of the losses can be significantly reduced with improved design. The prospect of large scale deployment of virtual impactors for continuous air monitoring is favorable. (auth)

23950 RADIOMETRIC DETERMINATION OF CADMIUM IN ZINC INDUSTRY PREPARATIONS. Martynov, A. M.; Shamaev, V. I. (Moscow Chemical-Tech. Inst.). Tr. Mosk. Khim.-Tekhnol. Inst.; No. 71, 240-241(1972). (In Russian).

For the determination of Cd in the presence of up to a 1000-fold excess of Zn, the test solution (labeled with ^{115m}Cd) is treated with ammoniacal buffer solution of pH 10.0 to mask the Zn^{2+}; then a substoichiometric amount (relative to the Cd) of Na diethyldithiocarbamate solution is added. The Cd diethyldithiocarbamate is then extracted into an equal volume of $CHCl_3$, the fraction of the radioactivity extracted is measured, and from this the Cd content of the sample is calculated. A determination takes ≃25 min., and the error in determining ≃0.7 mg of Cd is <4%. (Anal. Abstr.)

23951 RADIOMETRIC DETERMINATION OF CHROMIUM IN VANADIUM-INDUSTRY PREPARATIONS. Shamaev, V. I.; Savkin, M. E.; Churilova, M. A. (Moscow Chemical-Tech. Inst.). Tr. Mosk. Khim.-Tekhnol. Inst.; No. 71, 230-236(1972). (In Russian).

For the determination of Cr in the presence of up to a 70-fold excess of V, the test solution (labelled with ^{51}Cr) is adjusted to pH 1, then aqueous H_2O_2 is added, and the mixture is boiled. The solution is then made alkaline, and the precipitated $Cr(OH)_3$ is collected and treated to give a solution of Cr^{VI} with a pH of >5.5. To aliquots of this solution are added different volumes of 0.32M-$BaCl_2$, each precipitate of $BaCrO_4$ is filtered off, and the radioactivity of each filtrate is measured (or each precipitate is dissolved and the radioactivity of the resulting solution is measured). The content of Cr in the sample is calculated from a given equation. (Anal. Abstr.)

23952 ADVANCES IN X-RAY ANALYSIS. Volume 16. Proceedings of the Twenty-First Annual Conference on Applications of X-Ray Analysis Held at Denver, Colorado, August 2–4, 1972. Birks, L. S.; Barrett, C. S.; Newkirk, J. B.; Ruud, C. O. (eds.). New York; Plenum Publishing Corporation (1973). 420p. (CONF-720801-). $25.00.

Thirty-seven papers were presented at the conference and separate abstracts were prepared for 17 papers. (LK)

For abstracts of individual papers see: 23896, 23953–23957, 24039, 24271, 24315–24317, 24374–24378, and 24665.

23953 APPLICATIONS OF X-RAY ANALYSIS TO ENVIRONMENTAL AND BIOMEDICAL STUDIES. Gilfrich, J. V. (Naval Research Lab., Washington, DC). Advan. X-Ray Anal.; 16: 1-9 (1973).

From applications of x-ray analysis conference; Denver, Colorado, USA (2 Aug 1972). See CONF-720801-.

Recent developments in x-ray spectroscopy have shown that this technique is a very powerful tool for the analysis of small quantities of material. A distinction must be made here between microanalysis (the analysis for elemental composition of a small total amount of material) and trace analysis (the analysis of bulk material for the presence of certain elements at very low concentrations). By the use of chemical separation, a problem in trace analysis can be converted into a microanalytical situation. A major improvement in trace analysis has been achieved by the use of ion-exchange resin loaded onto filter paper to collect the elements(s) of interest from a solution of the original sample. The analysis of these concentrates or of particulate matter filtered out of polluted air or water can be optimized because the total mass of the sample is small and the background due to scattered primary radiation can be minimized. Much interest has become manifest recently in the use of solid-state detectors for energy dispersion x-ray analysis of samples of this type. The value of energy dispersion can be demonstrated by improved detection limits for samples containing only a few widely separated elements. However, resolution of state-of-the-art solid-state detectors is not adequate to separate the $K\beta$ of one element from the $K\alpha$ of the next higher atomic number among the transition metals. Thus the presence of a large number of immediate neighbor elements at widely different concentrations as in pollution samples suggests the need for crystal spectrometers. (auth)

23954 DIFFERENTIAL PHOTOIONIZATION CROSS SECTION OF NEON SUBSHELLS FOR THE X-RAY ANALYSIS BY PHOTOELECTRON SPECTROMETRY. Wuilleumier, F. (Oak Ridge National Lab., TN). Advan. X-Ray Anal.; 16: 63-73(1973).

From applications of x-ray analysis conference; Denver, Colorado, USA (2 Aug 1972). See CONF-720801-.

The new x-ray analysis method using photoelectron spectrometry demands knowledge of differential photoionization cross sections of the subshells of the converter atoms used as intermediary between the x-ray spectrum and the photoelectron spectrum. These differential cross sections were determined for the most appropriate converter, the neon atom, in the energy range from 50 to 3000 eV. The total photoionization cross section was partitioned into contributions that arise from single ionization in the various subshells and from multiple processes. We present in tabular and graphical form: (a) 1s, 2s and 2p total subshell cross sections; (b) 1s, 2s and 2p differential cross sections at 54.73°; and (c) 1s, 2s and 2p differential cross sections at 90°. Accuracy is considered to be better than 3, 7 and 5% at all energies for 1s, 2s and 2p cross sections, respectively. (auth)

23955 SENSITIVITY AND DETECTABILITY LIMITS FOR ELEMENTAL ANALYSIS BY PROTON-INDUCED X-RAY FLUORESCENCE WITH A 3 MV VAN de GRAAFF. Umbarger, C. J.; Bearse, R. C.; Close, D. A.; Malanify, J. J. (Los Alamos Scientific Lab., NM). Advan. X-Ray Anal.; 16: 102-110(1973).

From applications of x-ray analysis conference; Denver, Colorado, USA (2 Aug 1972). See CONF-720801-.

Protons from a 3-MV Van de Graaff have been used to produce characteristic x-rays from 21 elements spanning the periodic table. Absolute K_α and L_α x-ray production cross sections have been determined, allowing one to calculate sensitivities for any given sample, detector geometry, and proton beam parameters. Elemental detectability limits are discussed assuming various backings (e.g., mylar and kapton) and matrix materials. The large number of available small proton accelerators throughout the United States promises wide applicability of this technique to environmental and biomedical analysis. (auth)

23956 IN VIVO ANALYSIS OF LIPID– PROTEIN RATIOS IN HUMAN MUSCLE BY DIFFERENTIAL X-RAY ABSORPTION USING ^{109}Cd PHOTONS. Preuss, L. E.; Bolin, F. P. (Edsel B. Ford Inst. for Medical Research, Detroit). Advan. X-Ray Anal.; 16: 111-123(1973).

From applications of x-ray analysis conference; Denver, Colorado, USA (2 Aug 1972). See CONF-720801-.

The combination of accuracy, speed, and compactness makes the ^{109}Cd two-photon absorptiometric method a promising possibility for the determination of fat-lean ratios in living subjects. The accuracy possible with this method promises to be of use in unraveling some of the more difficult problems relating to body composition. In vitro work has been highly successful and various techniques are being explored for the application of the method to living subjects. (auth)

23957 X-RAY SPECTROMETRIC DETERMINATION OF ATMOSPHERIC AEROSOLS. Chessin, H.; McLaren, E. H. (State Univ. of New York, Albany). Advan. X-Ray Anal.; 16: 165-176(1973).

From applications of x-ray analysis conference; Denver, Colorado, USA (2 Aug 1972). See CONF-720801-.

X-ray spectrometric analysis is examined as an analytical tool for elemental determinations of atmospheric aerosols. Contamination levels of the several filters used for collection purposes are examined and the results reported. A calibration technique is described for analysis of several elements in the microgram range based on collection of saturated vapors of aqueous salt solutions. The calibration curves together with an analysis of sensitivity and lower limits of detection are shown. The technique is employed to monitor continuously aerosol content in the atmosphere during passage of a cold front. (auth)

23958 DETERMINATION OF HAFNIUM IN ZIRCONIUM BY RADIOCHEMICAL METHODS. III. Calibrated Curves Method Using Extraction With TBP. Shamaev, V. I.; Garbauskas, G. K. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 133-135(1973).

Translated from Radiokhimiya; 15: No. 1, 132-134(1973).

A simple and rapid radiometric calibration curves method was developed for the determination of hafnium in zirconium using extraction from sulfuric acid solutions of thiocyanate complexes of zirconium and hafnium with TBP solutions. The method gives adequate accuracy with a hafnium content above 1% and makes it possible to carry out rough determinations (with a relative error of the order of 20%) with Hf contents in Zr of tenths of a percent. (auth)

23959 RELATIVE SENSITIVITY AND ACCURACY OF NaI(Tl) AND Ge(Li) DETECTORS FOR MINOR COMPONENTS. Lucas, H. F. Jr.; Edgington, D. N. (Argonne National Lab., IL). J. Radioanal. Chem.; 15: No. 2, 467-472(1973).

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A mixture of ^{233}Pa, ^{140}La, ^{82}Br, ^{64}Cu, ^{72}Ga, ^{60}Co, and ^{24}Na of known disintegration rates was counted on a NaI(Tl) and a large Ge(Li) detector. Both systems detected ^{233}Pa when present at 0.2%, and accurate results were observed for ^{233}Pa, ^{140}La, and ^{60}Co when present at greater than 0.5% of the total disintegration rate. The accuracy of the results from either system was not significantly different since the mean ratio of the observed to true results was 0.99 ± 0.05 and 1.06 ± 0.06, respectively. However, equal sensitivity and accuracy were achieved only when the counting interval for the germanium system was 1000 min, or 60 to 600 times that for sodium iodide. (auth)

23960 X-RAY FLUORESCENCE SPECTROSCOPIC METHODOLOGY IN TRACE-ELEMENT ANALYSIS: A CRITIQUE, AND AN APPLICATION TO THE ASSESSMENT OF THE TRACE-ELEMENT STATUS OF COWS GIVEN PROTEIN-FREE FEED. Heikonen, M. Otaniemi, Finland; Helsinki University of Technology (1973). 107p.

Thesis.

A review of the x-ray fluorescence technique and of methods for ashing biological materials is presented. Methods used for pre-treatment of samples of protein-free feed and of bovine faeces, urine, milk, and tissues and conditions used for the determination of Ti, V, Co, Zn, Br, Sr, Rb, Mo, Ba, Cr, Mn, Fe, Ni, and Cu are described. Established methods were used for alkaline phosphatase, cyanocobalamin, Cu, Fe, PO_4^{3-} and protein-bound iodine; spark-source mass spectroscopy was used for Co; a F^--selective electrode for F^-; an activation method for Se; and atomic-absorption spectrophotometry for Na, K, Ca, Mg, Mn, Fe, Cu and Zn. Causes of variability in the results by x-ray fluorescence are considered; recoveries by this technique were >90% for all the elements determined; detection limits ranged from 3 to 40 mg per kg of sample ash and the results differed by <20% from those by atomic absorption. The results and their significance are discussed. (363 references) (Anal. Abstr.)

23961 BASIC CONCEPTS OF SATURATION ANALYSIS TECHNIQUES. Ekins, R. P. (Middlesex Hospital Medical School, London). Curr. Top. Exp. Endocrinol.; 1: 1-39(1971).

The basic principles underlying saturation assay techniques are described. It is fundamentally akin to activation analysis in that it depends upon the radioactivation of the compound under test. However, the activation is achieved by chemical reaction with a labeled reagent rather than by physical means. A major disadvantage of the technique is the nonspecificity of the primary chemical reaction on which the method depends. Employment of labeled antibody specific in its reaction with the test compound, as labeled reagent, has improved the specificity of the method. Currently the technique is used in the assay of protein hormones but will most likely be extended to other compounds also such as thyroid and steroid hormones, against which antisera can be raised by appropriate means. Assay design, sensitivity, precision, specificity, and some practical aspects of saturation assay procedures are all discussed. (ERB)

Separation Procedures

Refer also to abstracts 24026, 24092, 24118, 26201, 26497, and 26501.

23962 (AEC-tr-7524) AUTOMATED ION-EXCHANGE SEPARATION OF URANIUM AND PLUTONIUM FROM FISSION PRODUCTS FOR MASS SPECTROMETRIC ANALYSIS. Bol, D.; Brandalise, B.; Bier, A.; DeRossi, M.; Koch, L. (Commission of the European Communities, Karlsruhe (F.R. Germany). European Inst. for Transuranium Elements). Mar 1973. Translation by Rebecca Greer of EUR-4927. 20p. Dep. NTIS $3.00.

An automated procedure for the separation of uranium and plutonium from irradiated nuclear fuels for isotopic analysis by mass spectrometry was developed. As many as six samples can be separated simultaneously on ion-exchange columns. The addition of the wash and eluting solutions, as well as the collection of as many as five fractions per column, is automated. The volumes of wash and eluting solutions and that of the fractions may be selected for each column. The liquid level of each column is controlled by a photocell. Delivery pumps, valves and fraction collectors are operated by a control unit based on digital techniques. (auth)

23963 (CONF-720591) SOLVENT EXTRACTION IN METALLURGICAL PROCESSES. Proceedings of International Symposium, Antwerp, Belgium, May 4-5, 1972. (Koninklijke Vlaamse Ingenieurvereniging, Antwerp (Belgium). Technologisch Inst.). 1972. 81p.

Ten papers were presented at the international symposium, and separate abstracts were prepared for three papers. One paper was previously abstracted for NSA and appeared as abstract 27: 17161. (LK)

For abstracts of individual papers see: 23964, 23965, and 24023.

23964 (CONF-720591, pp 6–15) TECHNOLOGY OF SOLVENT EXTRACTION IN METALLURGICAL PROCESSES. Hanson, C. (Univ. of Bradford, Eng.). 1972.

From international symposium on solvent extraction in metallurgical processes; Antwerp, Belgium (4 May 1972).

The equation for the solute-solvent interaction when uranium is extracted from an aqueous phase into TBP is discussed. Flowsheet design and extraction equipment used in solvent extraction are reviewed. (LK)

23965 (CONF-720591, pp 48–53) AKUFVE: TECHNIQUE FOR RESEARCH AND DEVELOPMENT IN SOLVENT EXTRACTION. Reinhardt, H.; Rydberg, J. (Chalmers Univ. of Tech., Goteborg). 1972.

From international symposium on solvent extraction in metallurgical processes; Antwerp, Belgium (4 May 1972).

The AKUFVE-system is a major improvement in research and development of solvent extraction processes, not only because of speed and precision in the experimental procedure but because it simplifies the study of such solvent extraction phenomena as kinetics. This will definitely generate further investigations exploring the interesting possibilities of using, for example, differences in reaction rates to increase separation factors, which is a field that is very hard to investigate using conventional techniques. The AKUFVE is a new research facility which will be of use for the development of new solvent extraction processes and for better optimization of existing processes to the benefit of the hydrometallurgical industry. (auth)

23966 USE OF AN ION-EXCHANGE METHOD FOR ISOLATION OF MOLYBDENUM FROM CONCENTRATED SODA SOLUTIONS. Andronov, E. A.; Lukicheva, T. M.; Kuzin, I. A. J. Appl. Chem. USSR (Engl. Transl.); 46: No. 8, 1892–1896(Aug 1973).

Translated from Zh. Prikl. Khim.; 46: No. 8, 1783–1787 (Aug 1973).

Practical data obtained in large-scale laboratory experiments show that the ion-exchange method is promising for production of high-quality ammonium paramolybdate from soda solutions with high molybdate concentrations, obtained by leaching of calcines formed by roasting of both high- and low-grade molybdenum concentrates. (auth)

23967 STUDY OF THE RETENTION OF TRANSITION ELEMENTS (Mo, Ru, Rh, Pd, Cu, Ag, W, Re, AND Os) ON SOME SULFIDES USING RADIOACTIVE TRACERS. Chayla, B. (CEN de Saclay, Gif-sur-Yvette, France). Analusis; 2: No. 8, 590–596 (Sep 1973). (In French).

The behavior of some elements (Mo, Ru, Rh, Pd, Cu, Ag, W, Re, and Os) on some sulfides (MoS_2, HgS, CuS, PbS) was studied in halogenated acid media. Some separation possibilities were established particularly for PbS. The problem of different mechanisms was studied using the lines adopted in the Plackett and Burmann experiment. For the group of elements studied, two kinds of mechanism were established for PbS: displacement reaction with Cu, Ag, and Pd; precipitation of lead molybdate for Mo. (FR)

23968 SEPARATION OF URANIUM(VI) FROM SODIUM CHLORIDE MEDIUM WITH CHELONIT. Jaehnig, W. (Paedogog. Hochsch., Guestrow, Ger.). Z. Chem.; 13: No. 6, 227–228(1973). (In German).

Quantitative recovery of UO_2^{2+} from 0.1M-NaCl or 3M-NaCl medium was achieved with the iminodiacetate resin Chelonit or Wofatit MC 50, respectively. The UO_2^{2+} was eluted with M-HNO_3 in each instance. Higher concentrations of NaCl prevented the quantitative adsorption of UO_2^{2+}. (Anal. Abstr.)

23969 SORPTION OF CALCIUM, STRONTIUM, AND BARIUM IONS BY MORDENITE. Chernyavskaya, N. B.; Andreeva, N. R. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 108–110(1973).

Translated from Radiokhimiya; 15: No. 1, 111–113(1973).

The absorption of Ca^{2+}, Sr^{2+}, and Ba^{2+} from solutions of the corresponding nitrates by Na-mordenite was investigated. The equivalence of the exchange $2Na^+ \rightleftharpoons Ca^{2+}$ (Sr^{2+}, Ba^{2+}) was established. The exchange capacities of Na-mordenite with respect to Ca^{2+}, Sr^{2+}, and Ba^{2+} were determined. It was established that the cations investigated differ insignificantly in degree and rate of absorption and may be arranged in the following series: $Ba^{2+} > Sr^{2+} > Ca^{2+}$. (auth)

23970 SORPTION OF EUROPIUM BY MORDENITE. Grebenshchikova, V. I.; Chernyavskaya, N. B. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 111–113(1973).

Translated from Radiokhimiya; 15: No. 1, 114–116(1973).

By the example of the system Eu^{3+}–Na-mordenite it was established that mordenite can be used to extract rare earth elements from solutions. The capacity of mordenite for europium falls with an increase in the solution acidity: at pH 3.5 the capacity is 23 mg Eu/g mordenite and at pH 2.4 the capacity equals 9.8 mg Eu/g mordenite. In the presence of foreign ions the capacity falls to zero, which indicates an ion exchange mechanism for the absorption of europium. (auth)

23971 EFFECT OF SURFACE-ACTIVE SUBSTANCES ON THE SORPTION OF RADIOACTIVE ELEMENTS BY NATURAL SORBENTS. Fominykh, V. E.; Pustovalov, N. N.; Pushkarev, V. V. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 114–116 (1973).

Translated from Radiokhimiya; 15: No. 1, 116–118(1973).

The effect of various surface-active substances (SAS) on the sorption of ^{144}Ce and ^{106}Ru by phlogopite was studied. Addition of SAS to samples of phlogopite with ^{144}Ce sorbed on them causes desorption of the ^{144}Ce. Surface-active substances have a slight effect on the sorption of ^{106}Ru. Therefore, when the solutions contain SAS, phlogopite is most effective in absorbing radioisotopes in a negatively charged form. (LK)

23972 EFFECT OF THE STRUCTURE OF ORGANOPHOSPHORUS ACIDS ON THE EXTRACTION OF URANYL NITRATE BY DIFFERENT MECHANISMS. Rozen, A. M.; Martynov, B. V.; Anikin, V. I.; Mamaev, L. A. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 120–122(1973).

Translated from Radiokhimiya; 15: No. 1, 121–123(1973).

The extraction of uranium(VI) from nitric acid solutions by organic acids of the series $(RO)_2$—·POOH—(RO)RPOOH—R_2POOH was studied. The effective extraction constants for the ion-exchange, exchange-solvate, and solvate mechanisms were determined. It was found that in the strongly acid region the exchange-solvate mechanism is the main one for dialkylphosphoric acids and the solvate mechanism is the main one for phosphinic acids. The solvate mechanism shows the greatest structural sensitivity, while the ion-exchange and exchange-solvate mechanisms show the least. (auth)

23973 EXTRACTION POWER OF SULFOXIDES. VIII. Coordination of Metals by Sulfoxides. Rozen, A. M.; Murinov, Yu. I.; Nikitin, Yu. E.; Teterin, E. G.; Kaminskaya, L. K.; Mazalov, L. N.; Gal'tsova, E. A. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 123–125(1973).

Translated from Radiokhimiya; 15: No. 1, 123–125(1973).

The ir and x-ray K-spectra of sulfoxides and their complexes with metal salts were studied. It was shown that tellurium, uranium, thorium, and zirconium are coordinated by the oxygen of the sulfoxide group and palladium is coordinated by the sulfur (probably involving a π-dative mechanism). It was found that the frequency of the vibrations of the SO group depends weakly on the structure of the sulfoxides. This confirms a conclusion drawn previously that the increased extraction power of cyclic sulfoxides is explained by the effect of the entropy factor and not by an increase in the bond energy. (auth)

23974 EFFECT OF CATION OF SALTING-OUT AGENT ON SEPARATION OF TRIVALENT ACTINIDE ELEMENTS BY EXTRACTION WITH AMIDES. Chudinov, E. G.; Pirozhkov, S. V. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 16–21(1973).

Translated from Radiokhimiya; 15: No. 1, 18–23(1973).

The distribution coefficient of americium, curium, berkelium, californium, cerium, and europium was measured for extraction from 2.4 and 4.0 M solutions of alkali metal nitrates by 0.4 M tetraoctylammonium nitrate solution and 4.5 M trioctylammonium nitrate solution in o-xylene. A decrease in the hydration of the cation of the salting-out agent causes the distribution coefficient to fall. The separation factor of the elements studied (relative to curium) reaches a maximum in extraction from solutions of ammonium or sodium nitrate. The results obtained are best explained from the point of view of Samoilov's qualitative structural theory of salting out. (auth)

23975 MECHANISM OF EXTRACTION OF URANYL NITRATE FROM NITRIC ACID SOLUTIONS BY ORGANOPHOSPHORUS ACIDS. Rozen, A. M.; Martynov, B. V.; Anikin, V. I. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 22–27(1973).

Translated from Radiokhimiya; 15: No. 1, 24–30(1973).

The mechanism of the reaction of uranyl nitrate with D2EHPA in acid media was studied by the extraction method. It was shown that the extraction of uranium(VI) in media with a HNO_3 concentration greater than 2.0 M proceeds by an exchange-solvate mechanism with the formation of the mixed complex $UO_2NO_3HR_2(HR)_2$, containing one inorganic and one organic anion. The extraction constant equals 12,00; the purely solvate complex $UO_2(NO_3)_2 \cdot 2HR$ is hardly formed. In extraction from weakly acid media (up to 0.4 M) the extraction proceeds by an ion exchange mechanism ($\log D = K + 2pH$); the extraction constant was found to equal $8.1 \cdot 10^3$. An equation was obtained for determining the distribution coefficient of uranium(VI) over all ranges of acidity in extraction by D2EHPA. The inaccurate conclusions of previous studies of the composition of the complex at an acidity higher than 2 M resulted from the neglect of changes in the activity coefficients of uranyl nitrate. (auth)

23976 EXTRACTION OF AMERICIUM(III) LANTHANUM(III), AND NEODYMIUM(III) FROM LACTIC ACID SOLUTIONS BY DI-(2-ETHYLHEXYL) PHOSPHORIC ACID IN THE PRESENCE OF LARGE AMOUNTS OF RARE EARTH ELEMENTS. Lunichkina, K. P.; Renard, E. V. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 28-33(1973).

Translated from Radiokhimiya; 15: No. 1, 30-35(1973).

The extraction of tracer amounts of Am from lactate–nitrate solutions into solutions of D2EHPA in PAB (technical mixture of isomers of alkylbenzenes) was studied with varying pH of the aqueous phase and concentrations of extractant and lanthanum in the organic phase. It was established that there is coextraction of lactate ions with Am(III) into D2EHPA and the reaction mechanism of the extraction depends on the presence of macroamounts of an extractable element (lanthanum). In the absence of lanthanum the experimental data agree with the extraction reaction: $AmL_n^{3-n} + 3(HR)_2 \rightleftharpoons AmL_n(HR_2)_{3-n} \cdot n\,(HR)_2 + (3-n)\,H^+$, where n = 1-2, while the large amounts of lanthanum present in the system the data with the reaction $AmL_n^{3-n} + (3-n)\,HR \rightleftharpoons AmL_nR_{3-n} + (3-n)\,H^+$, where n = 1-2. The capacity of the extractant with respect to La and Nd was determined and it was shown that D2EHPA extracts REE (macroamounts) from lactate media in the form of the complex LnR_2L. (auth)

23977 EXTRACTION OF ALKALINE EARTH ELEMENTS BY SALICYLALDOXIME. Prokopchuk, Yu. Z.; Brezhneva, N. E.; Korpusov, G. V.; Prokhorova, N. P. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 41-47(1973).

Translated from Radiokhimiya; 15: No. 1, 42-49(1973).

The extraction of calcium, strontium, and barium by solutions of salicylaldoxime in TBP and DAMPA was investigated. A mechanism is proposed for the extraction of AEE (alkaline earth element) salicylaldoximates. The reaction constants were calculated for the extraction of AEE: $pK_{Ca} = 19.1 \pm 0.7$, $pK_{Sr} = 20 \pm 0.8$, $pK_{Ba} = 21.4 \pm 0.6$. The optimal conditions were selected for the separation of AEE and an experimental check was carried out on the separation of the binary mixtures Ca–Sr and Sr–Ba. The experimental results show that SAO is quite promising for technological application. (auth)

23978 EFFECT OF NATURE, DIMENSIONS, AND SYMMETRY OF MOLECULES ON EQUILIBRIUM OF CHEMICAL REACTIONS. V. Formation of Complexes With Three Ligands. Komarov, E. V.; Shpunt, L. B. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 48-52 (1973).

Translated from Radiokhimiya; 15: No. 1, 49-54(1973).

On the basis of the molecular statistical model for an extraction reaction proposed previously formulas were derived for calculating the ratio of the equilibrium constants of the extraction of trivalent metal salts by normal trialkyl phosphates in inert solvents. The values of K_S/K_S^0, where K_S and K_S^0 are the equilibrium constants of the extraction investigated and the standard extraction, respectively, were calculated for the extraction of europium nitrate by a series of trialkyl phosphates from tri-n-butyl phosphate to tri-n-decyl phosphate. The coefficients for the distribution of europium nitrate and nitric acid between aqueous solutions and solutions of tri-n-butyl, tri-n-hexyl, tri-n-octyl, and tri-n-decyl phosphates in CCl_4 and n-decane were determined experimentally. The satisfactory agreement between the calculated and experimental values of K_S/K_S^0 shows that the molecular statistical model proposed for extraction is suitable for describing equilibria in extraction systems in which the stoichiometry coefficient equals three. (auth)

23979 SEPARATION OF RADIOACTIVE ALKALINE EARTH ELEMENTS. II. Extraction of Alkaline Earth Elements by Solutions of Dihalogen Derivatives of Oxine in TBP. Prokopchuk, Yu. Z.; Korpusov, G. V.; Brezheva, N. E. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 34-40(1973).

Translated from Radiokhimiya; 15: No. 1, 35-42(1973).

The extraction of calcium, strontium, and barium by solutions of 5, 7-dichlorooxine, 5,7-dibromooxine, and 5,7-diiodooxine in TBP was investigated. It was established that dihalogen derivatives of oxine have a number of advantages over oxine as extractants for alkaline earth elements (higher distribution coefficients and lower solubility in aqueous solutions containing considerable amounts of acids). The most soluble derivatives 5,7-dichlorooxine (0.07 M/liter TBP) and 4,7-dibromooxine (0.03 M/liter TBP) are convenient for practical application. It was shown that in the extraction of alkaline earth elements by solutions of dihalogen derivatives of oxine in TBP there is a synergistic effect and in this case the distribution coefficients are much higher than in extraction by solutions of dihalogen derivatives of oxine in inert solvents or by pure TBP. (auth)

23980 SELECTIVE SEPARATION OF URANIUM FROM OTHER ELEMENTS BY CATION-EXCHANGE CHROMATOGRAPHY IN HYDROBROMIC ACID AND HYDROCHLORIC ACID-ACETONE MIXTURES. Strelow, F. W. E.; Weinert, C. H. S. W. (National Chemical Research Lab., Pretoria). Talanta; 20: No. 11, 1127-1137(Nov 1973).

U(VI) can be separated from Ga, Fe(III), Bi, Pb, Cd, Zn, Cu(II), and Au(III) by quantitative elution with 0.50 M HBr in 86% acetone or with 0.35 M HBr in 90% acetone from a column of AG50W-X4 cation-exchange resin of 200 to 400 mesh particle size. U(VI) and many other ions are retained. U(VI) then can be eluted selectively with 0.50 M HCl in 83% acetone or with 0.35 M HCl in 85% acetone. Co(II), Mn(II), Mg, Ca, Ti(IV), Al, Zr, Th, and La are quantitatively retained by the column. These elements then can be eluted with 5 M HNO_3. At the higher acid concentration (0.50M) the separation between U(VI) and Li is not satisfactory but is excellent at the lower acid concentration; the U(VI) peak is sharper at the higher acid concentration. Separations are sharp and quantitative, as is demonstrated by results for some synthetic mixtures. Distribution coefficients and elution curves are presented. (auth)

23981 FORMATION OF MIXED SOLVATES AND SYNERGISM IN EXTRACTION OF MOLYBDENUM(VI) FROM HYDROCHLORIC ACID SOLUTIONS BY MIXTURES OF TRI-N-OCTYLAMMONIUM CHLORIDE AND TRIBUTYL PHOSPHATE. Shmidt, V. S.; Mezhov, E. A.; Tsevtkova, Z. N.; Shesterikov, V. N. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 126-127(1973).

Translated from Radiokhimiya; 15: No. 1, 126-127(1973).

Since the formation of mixed solvates and the related phenomenon of synergism are often observed in extraction by mixtures of neutral organophosphorus compounds, it is expected that these phenomena could also be observed in the extraction of metal salts by mixtures of these extractants and amine salts. This hypothesis was checked by the extraction of molybdenum(III) from hydrochloric acid solutions by mixtures of TBP and tri-n-octylammonium chloride. The possibility of formation of extractable complexes containing at the same time molecules of neutral organophosphorus extractants and amine salts, which was established in the present work, confirms the existence of parallelism between the rules of extraction of these different classes of compounds. (LK)

23982 SEPARATION OF THE RARE EARTH ELEMENTS BY ELECTROLYSIS OF CHLORIDE MELTS WITH USE OF LIQUID ZINC ELECTRODES. Kovalevskii, A. V.; Lebedev, V. A.; Nichkov, I. F. Tsvetn. Metal.; No. 11, 45-49(Nov 1973). (In Russian).

The temperature dependence of the emf between Zn alloys with Nd, La, Dy, Y, Er, and saturated Ce–Zn alloys is determined. The average valency of the Y, La, Ce, Nd, Dy, and Er ions formed during anode dissolution of their Zn alloys is established. The experimental separation coefficients of the rare earth elements agree satisfactorily with the calculated values. (tr-auth)

23983 RARE-EARTH SEPARATIONS BY MIXED ION-EXCHANGE COLUMNS. Karol, P. J. (Carnegie-Mellon Univ., Pittsburgh). J. Chromatogr.; 89: No. 2, 346-347(27 Feb 1974).

Comparison of elution peak volume ratios of two species as a measure of effectiveness of separation shows that the mixed resin technique offers no advantage over the use of a cation or anion exchange resin individually. (LK)

23984 STUDY OF STOICHIOMETRIC UPTAKE OF CATIONS BY SOME INORGANIC ION EXCHANGERS USING RADIOISOTOPES. Gill, J. S.; Tandon, S. N. (Univ. of Roorkee, India). Int. J. Appl. Radiat. Isotop.; 25: No. 1, 31-33(Jan 1974).

Radiotracers have been used for studying the stoichiometric uptake of ions on some inorganic ion exchangers. The plots between log K_d and pH have been drawn for Cs^+, Hg^{2+}, and Tl^{3+}. (auth)

23985 EXTRACTION OF THORIUM(IV), YTTRIUM(III), AND LANTHANUM(III) BY MESITYL OXIDE. Chen, E. C.; Lee, H. Y. (Quebec Iron and Titanium Corp., Sorel). J. Chem. Eng. Data; 18: No. 4, 387-388(Oct 1973).

Extraction of thorium(IV), yttrium(III), and lanthanum(III) by mesityl oxide was investigated. The aqueous phases were nitrate solutions with a nitric acid concentration varying from 3 to 12N. In all cases, the extraction increased with the HNO_3 and mesityl oxide concentrations but decreased slightly as the initial metal concentration was increased. The largest separation factors obtained between thorium and yttrium and between yttrium and lanthanum were 84.4 and 1.2, respectively. (auth)

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Refer also to abstracts 23954, 24638, 24665, 24716, 26154, 26270, 26498–26500, 26503, and 26505.

23986 (CEA-CONF-2448) CHEMICAL REACTIONS AND MASS TRANSPORT PROCESSES IN DONOR AND ACCEPTOR DOPED Al_2O_3 CRYSTALS. Cox, R. T. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1973. 11p. (CONF-730715-3). Dep. NTIS (U. S. Sales Only) $3.00.

From conference on lattice defects in ionic crystals; Marseille, France (2 Jul 1973).

Information about the chemical and transport properties of point defects in Al_2O_3 is given by ESR and optical spectroscopic studies of the oxidation and reduction of crystals which have been doped with the donor impurity titanium or the acceptor impurity magnesium. Gamma irradiation is involved in one of the treatments. (auth)

23987 (RD/B/N-2548) KINETICS OF THE LIQUID SODIUM–HYDROGEN REACTION AT TEMPERATURES BELOW 573°K. Whittingham, A. C.; Hobdell, M. R. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jun 1973. 26p. Dep. NTIS (U. S. Sales Only) $3.50.

The kinetics of the reaction of hydrogen with stirred liquid sodium have been investigated at constant volume in the temperature range 433-568°K and hydrogen pressure range 5.0 – 33.0 kNm^{-2}. The rate of hydrogen uptake has been shown to be directly proportional to hydrogen pressure at all temperatures and pressures, thus indicating a first-order reaction. It is suggested that the rate determining step involves dissociative adsorption of hydrogen and electron transfer at the liquid sodium surface, at which hydrogen anions are weakly adsorbed: H_2 (g) + 2e (from liquid sodium conduction band) → $2H^-_{ads}$. The activation energy for the reaction is 69.0(±8.0) kJ mol^{-1}. (auth)

23988 METHOD FOR THE SYNTHESIS OF 1-HYDROXY-ETHYLIDENE-1, 1-DISODIUM PHOSPHONATE (HEDSPA): A SKELETAL SEEKING RADIOPHARMACEUTICAL AFTER LABELING WITH ^{99m}Tc. Castronovo, F. P. Jr. (Massachusetts General Hospital, Boston). J. Nucl. Med.; 15: No. 2, 127-130(Feb 1974).

A method for the synthesis of the skeletal seeking agent, 1-hydroxy-ethylidene-1, 1-disodium phosphonate (HEDSPA), is presented. The method can be performed in any laboratory equipped with a suitable hood by combining phosphorous trichloride (PCl_3) and acetic acid (CH_3COOH). The diphosphonate remains chemically stable in crystalline form or in solution. (auth)

23989 INVESTIGATION ON THE ADSORPTION OF IODINE ON ACTIVATED CARBON. Tomassi, W.; Zwierzchowska, Z. Przem. Chem.; 52: No. 11, 750-752(Nov 1973). (In Polish).

Desorption of iodine deposited anodically on two activated carbons has been investigated by the electrochemical method. One of two investigated carbons, with wider pores, was a better sorbent of iodine than the other one, mainly narrowly porous. Almost the whole quantity of iodine is bound with carbon by means of a weak physical bond, and only an insignificant part in case of the better adsorbent by means of a slightly stronger mesochemical bond. Very slow desorption of the last 20% of iodine results from slow diffusion in the sorbent pores and from the absorption of a part of iodine in the crystallites of activated carbon. (auth)

23990 REFRACTORY COMPOUNDS AS ELECTRODE MATERIALS. Gorenbein, A. E.; Skripnik, V. A.; Fedorovskaya, L. F.; Epik, A. P. (Inst. of Problems of Materials Science, Kiev). pp 222-225 of Protective Coatings on Metals. Vol. 5. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp.(1973).

Electrochemical and corrosion behavior of Ti and Zr borides, Ti and Mo silicides, and borided, silicided, and carbidized Ti were investigated under conditions of electrode polarization in saturated NaCl solutions and nonaqueous solutions. Chlorine evolution and the H evolution potential were studied. Most of the materials are corrosion resistant (except Mo silicide) as cathodes in NaCl but not as anodes. (DLC)

23991 NEW FORM FOR MENDELEEV'S TABLE. Perrin, F. Compt. Rend., Ser. C; 277: No. 18, 809-812(5 Nov 1973). (In French).

A new form of Mendeleev's table is presented. It is complete and compact, and expresses in a strict manner the recurrences and regularities in the chemical properties of elements classified in terms of increasing atomic number. Lanthanides, actinides, and elements having atomic numbers of greater than 104 are incorporated. (FR)

23992 KINETICS OF THERMAL DECOMPOSITION OF UNEXTRACTABLE COMPOUNDS OF ZIRCONIUM IN NITRIC ACID SOLUTION. Yagodin, G. A.; Tarasov, V. V.; Kazak, V. G. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 117-119(1973).

Translated from Radiokhimiya; 15: No. 1, 118-121(1973).

The kinetics of thermal decomposition of the unextractable zirconium oxynitrate were studied in 5.0, 6.6, and 7.7N HNO_3 at 83.0, 90.0, and 99.0°C. Decomposition of the unextractable compound was shown experimentally to be a first-order reaction with respect to the starting substance. (LK)

Isotope Effects

Refer also to abstracts 24026, 24032, 24038, 24058, and 24062.

23993 (CEA-CONF-2476) THERMODYNAMIC ISOTOPIC EFFECTS OBTAINED BY SORPTION IN PALLADIUM OF HYDROGEN–DEUTERIUM MIXTURES UNDER VARIABLE PRESSURE. Botter, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91, Gif-sur-Yvette (France)). [nd]. 35p. (In French). (CONF-730651-2). Dep. NTIS (U.S. Sales Only) $3.75.

From isotope effects in physical and chemical processes meeting; Clug, Romania (25 Jun 1973).

Experimental results on the variations of the isotopic separation factor as a function of pressure are reported. The decrease of the isotopic separation factor α_1 during passage in α Pd-H phase was observed at room temperature by equilibration of the hydrogen-rich mixtures with palladium dispersed on α alumina. This decrease is accentuated toward the low equilibrium pressure by leading to values of α_1 less than 1. The fundamental interest in this phenomenon is related to the phase diagram of the Pd-H system. (tr-auth)

23994 THREE-ELEMENT REACTION COORDINATES. III. Barrier Curvature Effects on Intramolecular Kinetic Isotope Effects. Keller, J. H.; Yankwich, P. E. (Univ. of Illinois, Urbana). J. Phys. Chem.; 78: No. 5, 544-554(28 Feb 1974).

A study was made of the influence of curvature of the potential barrier on heavy-atom kinetic isotope effects calculated for reaction coordinates comprising nonzero displacements in three internal coordinates. Increase in barrier curvature may increase or decrease the isotope effect. In addition to the expected dependence on transition state bond force constants and geometry, reaction coordinate composition, and barrier curvature, the results depend in most cases on the specific selection of minor transition state force constants (required to meet the input restrictions of the method). Although chemically and physically reasonable choices of certain transition state parameters result in drastic reduction in redundancy of the output, further reduction depends on the development of criteria for assigning the barrier curvature and of rationale for selection of off-diagonal force constants. (auth)

23995 VIBRATIONAL ANALYSIS AND MOLECULAR STRUCTURE OF THE HYDROGEN POLYOXIDES, H_2O_3, H_2O_4, D_2O_3, AND D_2O_4. Arnau, J.L.; Giguère, P.A. (Department of Chemistry, Université Laval, Québec, Canada). J. Chem. Phys. 60: No. 1, 270-273 (1 Jan 1974).

The fundamental skeletal vibrations of the H_2O_3 and H_2O_4 molecules and their deuterated analogs have been identified in the infrared or Raman spectra of the trapped products from reactions in electrically dissociated water vapor and related systems. All the observed frequencies have been assigned on the basis of assumed molecular structures of C_2 symmetry, consisting of skew chains of single-bonded oxygen atoms with an OH group at each end. The assignments are consistent with the temperature behavior, ^{18}O isotope shifts, and depolarization ratios of the various bands. Some unusual isotope effects were found in the deuterated species. A preliminary normal coordinate analysis of the skeletal vibrations of H_2O_3 and H_2O_4, including their ^{18}O isotopic species, shows satisfactory agreement of the calculated and observed frequencies, thereby supporting the assumed molecular model. It also confirms that the bonding in these very unstable molecules is similar to that in H_2O_2. (auth)

23996 EXACT QUANTUM MECHANICAL STUDY OF KINETIC ISOTOPE EFFECTS IN THE COLLINEAR REACTION $Cl+H_2 \rightarrow HCl+H$. THE H_2/D_2 AND THE H_2/T_2 ISOTOPE EFFECTS. Persky, A. (Department of Isotope Research, The Weizmann Institute of Science, Rehovot, Israel); Baer, M. J. Chem. Phys. 60: No. 1, 133-136 (1 Jan 1974).

Exact quantum mechanical probabilities for the collinear reaction of chlorine atoms with H_2, D_2, and T_2 in their ground and first vibrational excited states, were calculated for a semiempirical LEPS potential energy surface. These probabilities were used to calculate the kinetic isotope effects k_{Cl+H_2}/k_{Cl+D_2} and k_{Cl+T_2} which are compared with experimental data and with results of transition state theory calculations. The effect of the vibrational excitation of the hydrogen molecules on the rate of their reaction with chlorine atoms was also studied. (auth)

23997 INTRAMOLECULAR KINETIC ISOTOPE EFFECT IN THE REACTION OF FLUORINE ATOMS WITH METHANE-d_2 (CH_2D_2). Persky, A. (Department of Isotope Research, The Weizmann Institute of Science, Rehovot, Israel). J. Chem. Phys. 60: No. 1, 49-52 (1 Jan 1974).

The relative rates of the two competing isotopic reactions: $F + CH_2D_2 \rightarrow HF + CHD_2$ and $F + CH_2D_2 \rightarrow DF + CH_2D$, were measured in a fast flow system by direct mass spectrometric analysis of the reaction products in the temperature range of 159 to 298°K. The ratio of rates can be expressed as an Arrhenius type equation: $k_{F+HCHD_2}/k_{F+DCH_2D} = (0.81 + 0.03)\exp[(275 \pm 15)/RT]$. The relation between the intramolecular isotope effect k_{F+HCD_2D} and the intermolecular isotope effect k_{F+CH_4}/k_{F+CD_4} is discussed with regard to secondary isotope effects in the fluorine atom + methane reaction. (auth)

23998 DEUTERIUM QUADRUPOLE COUPLING IN FORMIC ACID. Ruben, D.J.; Kukolich, S.G. (Department of Chemistry, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). J. Chem. Phys. 60: No. 1, 100-102 (1 Jan 1974).

The $1_{01} \rightarrow 0_{00}$ and $3_{13} \rightarrow 3_{12}$ transitions of HCOOD were measured using a beam maser spectrometer with 4 kHz resolution. The measurements of three completely resolved components for each of these transitions allowed an unambiguous assignment of the spectrum. The quadrupole coupling strength in the O–D bond direction is $eq_{zz}Q = 272 \pm 3$ kHz with an asymmetry $\eta = -0.075 \pm 0.010$. Analysis of previous data on DCOOH yields a deuterium quadrupole coupling strength along the D–C bond direction of $eq_{zz}Q = 166$ kHz. (auth)

23999 MICROWAVE ROTATION–INVERSION SPECTRUM OF NT_3. Helminger, P.; De Lucia, F.C.; Gordy, W. (Department of Physics, Duke University, Durham, North Carolina 27706); Morgan, H.W.; Staats, P.A. Phys. Rev. A 9: No. 1, 12-16 (Jan 1974).

The rotation–inversion spectrum of $^{14}NT_3$ in the ground vibrational state has been measured with high–resolution microwave techniques in the frequency range of 210–633 GHz. Components of the $J = 0 \rightarrow 1$, $1 \rightarrow 2$, and $2 \rightarrow 3$ transitions were observed. Analysis of the results yielded the following rotational constants: $B_0 = 105\,565.373 \pm 0.034$ MHz, $D_J = 2.5981 \pm 0.0024$ MHz, and $D_{JK} = -4.472 \pm 0.006$ MHz, with the ^{14}N nuclear quadrupole coupling $eqQ = -4.170 \pm 0.049$ MHz. The inversion frequency, corrected for rotational distortion, was found to be 305.89 ± 0.11 MHz. Molecular substitution structures obtained were bond length 1.0132 Å and bond angle 107° 13′ for the combination $^{14}NH_3$: $^{15}NH_3$, $^{14}NT_3$; bond length 1.0128 Å and bond angle 107° 2′ for the combination $^{14}ND_3$: $^{15}ND_3$, $^{14}NT_3$. (auth)

24000 VIBRATIONAL SPECTRA AND STRUCTURE OF METHYL CHLOROFORMATE AND METHYL CHLOROFORMATE-d_3. Katon, J. E.; Griffin, M. G. (Miami Univ., Oxford, OH). J. Chem. Phys.; 59: No. 11, 5868-5876(1 Dec 1973).

The infrared spectra of methyl chloroformate and methyl chloroformate-d_3 are reported in the liquid and solid phases in the region 4000-50 cm^{-1}. The liquid phase Raman spectra of these compounds are also reported. It is found that the two compounds readily crystallize as oriented polycrystalline films when cooled in contact with cesium iodide windows. The polarized infrared spectra obtained with these films make possible an improved vibrational assignment for the light compound and a good first assignment for the deuterium-substituted analog. The results are most consistent with a planar cis structure and there is no indication of the existence of a second conformer. No clear cases of crystal splitting are observed. (auth)

24001 MIDINFRARED SPECTRA OF THE PLASTIC CRYSTAL PHASES OF t-BUTYL BROMIDE-h_9 AND -d_9. Bertie, J. E.; Sunder, S. (Univ. of Alberta, Edmonton). J. Chem. Phys.; 59: No. 7, 3853-3855(1 Oct 1973).

The midinfrared spectra of the two plastic phases of t-butyl bromide are identical to each other and are very similar to that of the liquid, except for small decreases in the half-widths of the bands as the temperature is lowered. It is shown that molecular reorientation and intermolecular vibrational coupling contribute to the half-widths, and the residual width is attributed to site effects. (auth)

24002 ROTATIONAL BAND SHAPES IN PHOTOELECTRON SPECTROSCOPY: HF AND DF. Walker, T. E. H.; Dehmer, P. M.; Berkowitz, J. (Argonne National Lab., IL). J. Chem. Phys.; 59: No. 8, 4292-4298(15 Oct 1973).

Rotational line strengths for ionization are calculated assuming only s partial waves. Rotational band contours are then constructed by broadening each rotational line with a known instrumental line shape. This technique is applied to HF and DF, and reproduces the experimental results well, allowing an accurate value of the spin-orbit coupling constant to be extracted from experiment. The value of -290 ± 10 cm^4 agrees with previous Hartree–Fock calculations. The ionization potentials (16.044 ± 0.003 eV for HF, 16.058 ± 0.003 eV for DF) are obtained with an accuracy one order of magnitude better than the experimental resolution, and there is some evidence for an electronic isotope shift. (auth)

24003 VIBRATIONAL BEHAVIOR OF THE SYN- AND ANTI-ACETAL ALDOXIMES. I. Vibrational Spectra. Geiseler, G.; Boehlig, H.; Fruwert, J. (Karl–Marx Univ., Leipzig). J. Mol. Struct.; 18: No. 1, 43-48(Sep 1973). (In German).

The infrared spectra of $CH_3CH = NOH$, $CH_3CH = NOD$, $CH_3CD = NOD$ and $CD_3CD = NOD$ were recorded and studied. On the basis of the symmetry properties the normal vibrations were assigned by comparison. (auth)

24004 ISOTOPE EFFECT ASSOCIATED WITH THE INSERTION OF RUBIDIUM IN GRAPHITE. Billaud, D. (Univ., Nancy); Herold A.; Leutwein, F. Compt. Rend., Ser. C; 277: No. 11, 419-420(17 Sep 1973). (In French).

The study of equilibrium between rubidium and the insertion compound RbC_8 indicated that the metal incorporated in graphite is richer in heavy isotope than free metal. An enrichment coefficient was found to be about 1,003. (FR)

24005 VIBRATIONAL SPECTRA AND STRUCTURE OF SODIUM BROMOACETATE AND SODIUM BROMOACETATE-d_2. Katon, J. E.; Kleinlein, R. L. (Univ. of Miami, Oxford, FL). J. Mol. Struct.; 17: No. 2, 239-248(Aug 1973).

The complete vibrational spectra of crystalline sodium bromoacetate and sodium bromoacetate-d_2 were recorded and a vibrational assignment proposed. The intermolecular coupling of these compounds is quite strong and the data are consistent with a centrosymmetric unit cell containing at least four molecules. The product rule calculations support a structure in which the bromine atom is rotated out of the plane of the remaining heavy atoms, but the frequency of the carbon–bromine stretching mode indicates that the degree of rotation is not large. (auth)

24006 VIBRATIONAL SPECTRA, NORMAL MODES, FORCE FIELD, AND BARRIER TO INVERSION OF PHOSPHIRAN, PHOSPHIRAN-1-d_1 AND PHOSPHIRAN-2,3-d_4. Bragin, J.; Dennis, L. W. (California State Univ., Los Angeles). J. Mol. Struct.; 18: No. 1, 75-92(Sep 1973).

The infrared spectra over the range of intramolecular fundamentals of polycrystalline phosphiran and phosphiran-1-d_1 at 77°K were obtained and the observed frequencies assigned. Correlation field effects were observed and analyzed in terms of the intermolecular forces operative in the unit cell. The intramolecular vibrations of phosphiran, phosphiran-1-d_1, and phosphiran-2,3-d_4 were subjected to simultaneous analysis in the approximation of harmonic forces and the resulting eigenvectors and potential energy distributions are presented. An estimate from the force field of the periodic barrier with inversion at phosphorus of 33 kcal $mole^{-1}$ was obtained and compared to results for similar molecules. Thermodynamic functions for phosphiran were calculated in the rigid rotor harmonic oscillator approximation. (auth)

24007 THERMOCHEMICAL ISOTOPE EFFECTS. Chloroform/Chloroform-d and Acetone/Acetone-d_6 in Selected Solvents. Duer, W. C.; Bertrand, G. L. (Univ. of Missouri, Rolla). J. Amer. Chem. Soc.; 96: No. 5, 1300-1304(6 Mar 1974).

Isotope effects on the heats of solution of the isotopic pairs chloroform/chloroform-d and acetone/acetone-d_6 have been measured in a variety of solvents at 25°C. While both positive and negative isotope effects have been observed for the heats of solution of these solutes, the transfer of the deuterated compound from cyclohexane (at infinite dilution) to other solvents is in every case more exothermic than the transfer of the parent compound. (auth)

24008 KINETIC STUDY OF THE HYDROLYSIS OF SUBSTITUTED N-BENZOYLIMIDAZOLES AND N-BENZOYL-N′-METHYLIMIDAZOLIUM IONS IN LIGHT AND HEAVY WATER. Hydrogen Bridging Without Rate-Determining Proton Transfer as a Mechanism of General Base Catalyzed Hydrolysis and a Model for Enzymic Charge-Relay. Choi, M. U.; Thornton, E. R. (Univ. of Pennsylvania, Philadelphia). J. Amer. Chem. Soc.; 96: No. 5, 1428-1436(6 Mar 1974).

Rates and kinetic solvent isotope effects for the title substrates have been studied at 15°. Isotope effects k_{H_2O}/k_{D_2O} on the order of 2.5, essentially independent of substituent, were found for the "uncatalyzed" hydrolysis of both substrates, as well as benzoylimidazolium ions, and for the methylimidazole-catalyzed hydrolysis of benzoylmethylimidazolium ions. The lyoxide term for the latter has inverse isotope effects k_{DO^-}/k_{HO^-} of 1.2 to 1.4, larger for more electron-supplying substituents, as expected for simple rate-determining nucleophilic attack on the carbonyl carbon atom. The lyoxide term for the benzoylimidazoles has isotope effects near 1.0. It is concluded that general base catalyzed hydrolysis, with water, methylimidazole, or lyoxide as general base as the case may require, is the problem mechanism for all terms studied (except the one case of simple nucleophilic attack), and that this mechanism consists of rate-determining nucleophilic attack by water with one proton partly transferred to the general base but not being transferred as part of the reaction coordinate motion. (auth)

24009 MECHANISM OF ACID CHLORIDE DECARBONYLATION WITH CHLOROTRIS(TRIPHENYLPHOSPHINE)RHODIUM(I). Stereochemistry and Direction of Elimination. Stille, J. K.; Huang, F.; Regan, M. T. (Univ. of Iowa, Iowa City). J. Amer. Chem. Soc.; 96: No. 5, 1518-1522(6 Mar 1974).

The decarbonylation of erythro- and threo-2,3-diphenylbutanoyl chloride with chlorotris(triphenylphosphine)rhodium(I) gave exclusively trans- and cis-methylstilbene, respectively. These results are best explained either by an acyl–alkyl rearrangement with retention and a cis β-hydride elimination, or a concerted cis elimination. The rates of the decarbonylation of dichloro(3-perdeuteriophenyl-3,3-dideuteriopropionyl)bis(triphenylphosphine)-rhodium(III) along with the undeuterated complex ($k_H = 3.34 \times 10^{-5}$ sec^{-1}, $k_D = 4.75 \times 10^{-6}$ sec^{-1}) showed a primary deuterium isotope effect of 7.04. Decarbonylation of 2-methylpentanoyl chloride, 2,2-dimethylpentanoyl chloride, 2-ethyl-3-methylbutanoyl chloride, and 2,3-dimethylbutanoyl chloride with trans-chlorocarbonylbis-(tri-phenylphosphine)rhodium(I) showed that this olefin-forming reaction preferred the Saytzeff elimination. (auth)

24010 CHROMIUM(IV) OXIDATION OF ALIPHATIC ALDEHYDES. Rocek, J.; Ng, C. S. (Univ. of Illinois, Chicago). J. Amer. Chem. Soc.; 96: No. 5, 1522-1529(6 Mar 1974).

The oxidation of aliphatic aldehydes in aqueous solution by chromium(IV) generated in situ from chromium(VI) and vanadium(IV) was studied. Propionaldehyde is oxidized in a practically quantitative yield to propionic acid. Pivaldehyde gives a mixture of pivalic acid, tert-butyl alcohol, and isobutylene. The aldehydes seem to react in their hydrated forms; the value of the ρ constant for the oxidation of aldehyde hydrates is −0.96. The reaction exhibits a moderate deuterium isotope effect ($k_H/k_D = 1.7$ for propionaldehyde and $k_H/k_D = 2.1$ for pivaldehyde), which is consistent with a hydrogen atom transfer in the rate-limiting step from the aldehyde carbon atom to the oxidant. A mechanism for the chromium(IV) oxidation analogous to that earlier suggested for the oxidation of alcohols is proposed, and conclusions concerning the overall mechanism of the chromic acid oxidation of aldehydes are presented. (auth)

24011 STUDY OF STERIC EFFECTS IN [2.2]METAPARACYCLOPHANES. A Steric Isotope Effect, Remote Substituent Effects on a Steric Barrier, and Other Steric Phenomena. Sherrod, S. A.; da Costa, R. L.; Barnes, R. A.; Boekelheide, V. (Univ. of Oregon, Eugene). J. Amer. Chem. Soc.; 96: No. 5, 1565-1581(6 Mar 1974).

The conformational flipping of [2.2]metaparacyclophanes requires intrusion by the substituent at the 8 position into the π-electron cloud of the para-bridged ring. It is shown that the kinetics of this process can readily be followed by a double irradiation nmr technique. The Arrhenius factors observed for the conformational flipping of [2.2]metaparacyclophane itself are $\Delta H^{\ddagger} = 0.5$ kcal/mol and $\Delta S^{\ddagger} = -8.8 \pm 2.4$ eu. Substitution of deuterium for hydrogen at the 8 position showed a k_D/k_H ratio of 1.20 ± 0.04, the largest steric isotope effect thus far observed. Similarly, substituents (F, Br, NO_2, OCH_3, $COCH_3$, and NH_2) placed at the 5 position have a marked effect on the rate of conformational flipping of [2.2]metaparacyclophane. The rate dependence on remote substituents has been interpreted in terms of two effects: a sterically induced polarity of the transition state resulting in a Hammett ρ value of $+1.05 \pm 0.09$, and a ground-state attractive interaction of the two aromatic rings (with electron-withdrawing substituents) associated with a Hammett ρ value of -1.36 ± 0.14. Both Hückel and CNDO calculations support the picture of a polar transition state for conformational flipping of [2.2]metaparacyclophane. A possible anomalous steric interaction between fluorine and a benzene π-electron cloud, suggested by earlier work, has been investigated through a study of conformational preference in [2.2]metaparacyclophanes with substituents on the para-bridged ring. However, the steric ordering deduced $H < F < CH_3 < Br$ is that generally accepted. [2.2](9,10)Anthracenometacyclophane (41) has been synthesized and its rate of conformational flipping has been shown to be 45 times as fast as that of [2.2]metaparacyclophane (1-H). (auth)

24012 NUCLEOPHILIC REACTIONS OF SULFITE ESTERS IN AQUEOUS MEDIA. King, L. H.; Kaiser, E. T. (Univ. of Chicago). J. Amer. Chem. Soc.; 96: No. 5, 1410-1417(6 Mar 1974).

The hydrolysis reactions of three sulfite esters, diphenyl sulfite (VIII), bis-p-nitrophenyl sulfite (IX), and phenyl p-nitrophenyl sulfite (X), in carboxylic acid buffers were examined as simple models for the corresponding pepsin-catalyzed processes. The observation of a substantial Bronsted β value, 0.85, for the monocarboxylate ion-catalyzed hydrolysis of VIII, as well as the finding that the kinetic solvent isotope effect $(k_{OAc})^{H_2O}/(k_{OAc})^{D_2O} = 1.32$, are consistent with the hypothesis that these reactions of VIII occur by nucleophilic catalysis. Similarly, the acetate-catalyzed solvolysis of IX and X is suggested to occur through a nucleophilic pathway. Support for the proposal that the nucleophilic attack of the carboxylate ions on the sulfites leads to the formation of mixed anhydride intermediates (eq 7) has been obtained by the detection of the acetohydroxamic acid produced when VIII, IX, and X are solvolyzed in acetate buffer in the presence of hydroxylamine. In the case of VIII measurement of the rate of acetohydroxamic acid production has indicated that under the conditions employed the rate-controlling step is mixed anhydride formation. In contrast to the solvolyses in carboxylic acid buffers, the direct kinetic detection of intermediates in the reactions of the sulfite esters VIII and X with hydroxylamine buffers has been accomplished. The rate constants for intermediate formation and decomposition were obtained by a computer-assisted kinetic analysis in the case of VIII and by observation of the reaction course at different wavelengths in the case of X. Through a combination of kinetic and synthetic experiments, the solvolysis of X in N,O-dimethylhydroxyl-amine buffer has been shown to proceed through the initial formation of phenyl methoxymethylamidosulfite (XI). The demonstration that reactive intermediates can be detected in model solvolytic reactions of sulfite esters provides encouragement for the search for conditions under which intermediates formed by nucleophilic attack by the active site enzymatic carboxylate groups of pepsin can be detected directly. (auth)

24013 PECULIARITIES OF THE HYDRATION OF IONS IN HEAVY WATER. Abrosimov, V. K. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 128-130(1973).

Translated from Radiokhimiya; 15: No. 1, 127-130(1973).

Enthalpy characteristics of isotope effects of hydration $(IEH)_H$ can be calculated by comparing changes in enthalpy when salts are dissolved in heavy and normal water. Alkali metal halides and alkaline earth metal chlorides were used in the study. The values of $(IEH)_H$ of cations are closely connected with structural changes in water and quantitatively characterize the difference in the structural rearrangements which occur in the hydration of cations in H_2O and D_2O; the values of $(IEH)_H$ of anions do not show such a close relation. They cannot be related solely to structural changes in water when a hydrogen atom is replaced by a deuterium atom. (LK)

24014 SIGMATROPIC REARRANGEMENT OF UNSATURATED ACETALS. A Mechanistic Study of the Thermal Isomerization of 5-Alkylidene-1,3-Dioxanes. Mutterer, F.; Fleury, J. P. (Ecole Superieure de Chimie, Mulhouse Cedex, France). J. Org. Chem.; 39: No. 5, 640-642(8 Mar 1974).

The preparation and pyrolysis of 2-tert-butyl-5-ethylidene-1,3-dioxane-2-d are described. A negative isotope crossover experiment and a deuterium kinetic isotopic effect are in favor of an intramolecular isomerization involving a concerted 1,5-hydrogen shift. Some conclusions on the transition state are discussed. (auth)

24015 ORGANOSULFUR CHEMISTRY. II. Highly Stereoselective Reactions of 1,3-Dithianes. Contrathermodynamic Formation of Unstable Diastereoisomers. Eliel, E. L.; Hartmann, A. A.; Abatjoglou, A. G. (Univ. of North Carolina, Chapel Hill). J. Amer. Chem. Soc.; 96: No. 6, 1807-1816(20 Mar 1974).

Treatment of the lithium derivative of cis-4,6-dimethyl-1,3-dithiane (1) with DCl gives nearly exclusively (over 99%) the equatorial 2-deuterio compound (1a), treatment with methyl iodide gives exclusively the equatorial methyl compound (r-2,cis-6,cis-4-trimethyl-1,3-dithiane, 2), and treatment with carbonyl compounds (formaldehyde, acetone, and pivalic aldehyde) gives the equatorial carbinols (4) in at least 99.8% isomeric purity. Treatment of the lithium derivative of the equatorial 2-methyl compound 2 with HCl yields exclusively the corresponding axial isomer 3 (r-2, trans-4,trans-6-trimethyl-1,3-dithiane); a similar "contrathermodynamic" equilibration occurs with the equatorial carbinols mentioned, above, with r-2-tert-butyl-cis-4,cis-6-dimethyl-1,3-dithiane and with cis-2,4,4,6-tetramethyl-1,3-dithiane, suggesting a very large preference of the intermediate 2-dithianyl-lithium compound to have the metal in the equatorial position. The high degree of this preference (over 6 kcal/mol) suggests operation of a stereoelectronic rather than a simple steric effect. Carboxylation of the lithium derivative of 2 gives exclusively the equatorial carboxy derivative, r-2,cis-4,cis-6-dimethyl-1,3-dithianecarboxylic acid (6), whereas methylation of the lithium derivative of 2-carbomethoxy-cis-4,6-dimethyl-1,3-dithiane with methyl iodide leads exclusively to the diastereoisomer 7. Lithiation followed by methylation of the two diastereoisomeric 2-deuterio-cis-4,6-dimethyl-1,3-dithianes indicates that the kinetic stereoselectivity of the lithiation is only by a factor of 8.6 ± 1.3 with an isotope effect of 2.5 ± 0.1. The preference of the lithium derivative or carbanion to be equatorial is thus largely thermodynamically controlled. (auth)

24016 MECHANISTIC STUDY OF THE REACTIONS OF 1,2-DISUBSTITUTED ALKENES WITH HYDROGEN BROMIDE IN ACETIC ACID. Pasto, D. J.; Meyer, G. R.; Lepeska, B. (Univ. of Notre Dame, IN). J. Amer. Chem. Soc.; 96: No. 6, 1858-1866 (20 Mar 1974).

The stereochemistry and kinetics of the addition reactions of hydrogen bromide and acetic acid to cis- and trans-2-butene and 3-hexene and cyclopentene in hydrogen bromide-acetic acid have been studied. The stereochemistry of the addition of deuterium bromide and acetic acid-O-d to cis- and trans-2-butene occurs 84 ± 2% anti, is invariant over a 100-fold concentration range of deuterium bromide, and is unaffected by the presence of added lithium bromide or lithium perchlorate. The stereochemistry of the addition reactions to cis- and trans-3-hexene is 84–85% anti. The stereochemistry of the addition reactions to cyclopentene is 96 ± 4% anti (no syn addition product detected by ir techniques) and is not altered on change in the concentration of deuterium bromide or by the presence of added lithium bromide or perchlorate. The kinetics of the reaction of cyclopentene with hydrogen bromide in acetic acid appear to obey the kinetic expression $-d[\text{alkene}]/dt = k_{RBr}[\text{alkene}][\text{HBr}]^2 + k_{ROAc}[\text{alkene}][\text{HBr}]$ in which alkyl bromide is derived only from the third-order term and alkyl acetate is derived only from the second-order term. k_{RBr} and k_{ROAc} vary slightly with change in the initial concentration of hydrogen bromide, the rate constants decreasing with decreasing hydrogen bromide and cyclopentene concentration; however, the rate expression appears to remain the same. This phenomenon is attributed to changes in the reaction medium with change in hydrogen bromide concentration. The hydrogen-deuterium kinetic isotope effect is found to be 0.48 ± 0.02 for cyclopentyl bromide formation and 0.63 ± 0.07 for cyclopentyl acetate formation. The effect of added lithium bromide and lithium perchlorate on the rate of reaction has been determined and is discussed. A mechanism for the addition reactions is proposed involving syn and anti AdE3 transition states in which the hydrogen ion is delivered to the carbon by undissociated hydrogen bromide as the nucleophilic portion of the addends is delivered to the β carbon. (auth)

24017 OXIDATION OF ALDEHYDES BY CHROMIUM(VI) AND BY CHROMIUM(V) IN 96% ACETIC ACID. Wiberg, K. B.; Szeimies, G. (Yale Univ., New Haven). J. Amer. Chem. Soc.; 96: No. 6, 1889-1892(20 Mar 1974).

The chromic acid oxidation of benzaldehyde in 96% acetic acid had been found to produce chromium(V) as an intermediate. The rate constants for the chromium(VI) and chromium(V) oxidations were obtained for benzaldehyde as well as for substituted benzaldehydes, benzaldehyde-d, and a group of aliphatic aldehydes. The data are compared with the previously obtained data on the oxidation of benzaldehyde by chromium(VI) and the intermediate valence chromium species. (auth)

24018 TRANSFER-HYDROGENATION AND TRANSFER-HYDROGENOLYSIS. III. Hydrogen Transfer from Dioxane to Olefins Catalyzed by Chlorotris(Triphenylphosphine)Rhodium(I). Nishiguchi, T.; Fukuzumi, K. (Nagoya Univ., Japan). J. Amer. Chem. Soc.; 96: No. 6, 1893-1897(20 Mar 1974).

Hydrogen transfer from 1,4-dioxane to olefins catalyzed by $RhCl(PPh_3)_3$ occurred. Stoichiometric amounts of paraffins and dioxene were formed from olefins and dioxane. After the reaction, the dioxane complex, $RhCl(PPh_3)_2(C_4H_8O_2)$, was isolated. The large value of the kinetic isotope effect, $R^H/R^D = 3.1$, in the use of octadeuteriodioxane and the kinetic result showed that the rate-determining step of the reaction is the dehydrogenation, that is, the formation of the monohydride complex, $RhClH(C_4H_7O_2)(PPh_3)_2$, by the oxidative addition of dioxane by the cleavage of a C–H bond. (auth)

24019 SECONDARY DEUTERIUM ISOTOPE EFFECTS IN THE BAEYER–VILLIGER REACTION. Winnik, M. A.; Stoute, V.; Fitzgerald, P. (Univ. of Toronto). J. Amer. Chem. Soc.; 96: No. 6, 1977-1979(20 Mar 1974).

Observed isotope effects for the Baeyer–Villiger reaction of $PhCD_2COCH_3$ (D_2), $PhCH_2COCD_3$ (D_3), and $PhCD_2COCD_3$ (D are reported. The isotope effect on the migrating group is smaller than expected; the general trend predicts a larger per deuterium isotope effect for RCH_2 than for CH_3. (LK)

24020 ELECTRIC DIPOLE MOMENTS OF LOW J STATES OF H_2O AND D_2O. Dyke, T. R.; Muenter, J. S. (Univ. of Rochester, NY). J. Chem. Phys.; 59: No. 6, 3125-3127(15 Sep 1973).

Molecular beam electric resonance spectroscopy has been used to make precision Stark effect measurements on the 1_{11}, 1_{10}, and 2_{11} rotational states of H_2O and the 1_{11}, 1_{10}, 2_{11}, and 3_{13} states of D_2O. These data have been analyzed using the dipole moment function of Clough, Beers, Klein, and Rothman [J. Chem. Phys. 59, 2254 (1973)] to obtain rotationless moments of 1.8546 ± 0.0004 D for H_2O and 1.8545 ± 0.0004 D and D_2O. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstract 24244.

24021 (FRNC-TH-440) STUDY OF ISOTOPIC EXCHANGE OF RADIOACTIVE CALCIUM AND CERIUM CATIONS WITH Y ZEOLITES IN AQUEOUS AND ALCOHOLIC SOLUTION. Guilloux, M. (Lyon-1 Univ., 69 (France)). 1973. 120p. (In French). Dep. NTIS (U. S. Sales Only) $8.00.

Thesis.

The isotopic exchange of y zeolite cations with calcium and cerium was studied. The experimental work was carried out utilizing the heterogeneous isotopic exchange between aqueous and alcoholic solutions of the cation considered and a zeolite powder containing a corresponding radioisotope. Aqueous phase exchanges demonstrate that a complex diffusion phenomenon is taking place which is capable of being decomposed into at least two distinct phases: a very slowly occurring phase representing 25 to 30% of the total exchange at ordinary temperatures and a very rapidly occurring phase. In alcoholic solutions, a rapid phase is always observed together with a slow diffusion phase although the exchange rates and diffusion coefficients may vary considerably with the nature and composition of the solvent. The results enable a hypothesis to be advanced on the ion exchange mechanism. The migration of the ions requires the crossing of two types of barrier: the large windows of the supercages (8A); the windows of the sodalite cages (2A). The two stages of the exchange kinetics can be related to these two types of barrier. (FR)

24022 SOME PROPERTIES AND REACTIONS OF 1-METHYL-3-PHOSPHOLANONE 1-OXIDE. Quin, L. D.; Stocks, R. C. (Duke Univ., Durham, NC). J. Org. Chem.; 39: No. 5, 686-690(8 Mar 1974).

1-Methyl-3-phospholanone 1-oxide (1) is in tautomeric equilibrium with 1-methyl-3-hydroxy-2-phospholene 1-oxide, permitting uncatalyzed rapid exchange with D_2O at the 2 position. In appropriate media, the ^{13}C NMR spectra of both keto and enol forms can be observed, giving conclusive assignment of the enol structure. Reactions of 1 can occur at oxygen (with diazomethane or ethyl chloroformate), at C-2 (with N-bromosuccinimide or Michael addition to 2-butenone), at C-3 (enamine formation), or at phosphorus (ring opening with base). Some of the functionally substituted phosphine oxides so obtained were reduced to the phosphines with trichlorosilane. Of particular importance was the reduction of 1 itself which gave 1-methyl-3-phospholanone, the first known ketophospholane. (auth)

Feed Materials Processing

Refer also to abstracts 24581, 24582, and 24591.

24023 (CONF-720591, pp 22-30) SURVEY OF REAGENTS USED FOR SOLVENT EXTRACTION IN EXTRACTIVE METALLURGY. Flett, D. S. (Warren Spring Lab., Hertfordshire, Eng.). 1972.

From international symposium on solvent extraction in metallurgical processes; Antwerp, Belgium (4 May 1972).

Sufficient data are available to permit a useful classification of commercially available reagents and to give general conclusions on their chemistry, as an aid to reagent selection. Hydrometallurgical processing of sulfide concentrates is considered to be a growth point for solvent extraction, requiring extractants which are capable of extraction of metal from much more concentrated solutions. Development of selective reagents is required for nickel in particular and for other metal ions as well as copper. Solvent-in-pulp processes (uranium ores) can show significant cost savings where costly solid/liquid separations are necessary for clear-liquid processing. (auth)

24024 METHOD OF OBTAINING URANIUM COMPOUNDS. Mercier, H.; Jean, R. (to Compagnie de Produits). French Patent 2,154,300. 28 Sep 1971. 13p. (In French).

A method of obtaining high purity uranium compounds by reacting ores or uraniferous concentrates with sulfuric acid and separating the nondissolved fractions of the resulting liquor L1 is described. The method involves the removal of the majority of the impurities present in L1 by bringing it to a water/free acid ratio, W/A, of between 0.16 and 0.26 and eliminating the S2 precipitate formed. The remaining liquid phase L2 is then diluted to a W/A ratio of between 0.35 and 0.5, and the S3 precipitate thus obtained is recovered. (FR)

Radiation Chemistry

Refer also to abstracts 24060, 24222, 24396, 24397, 24405, and 24839.

24025 (BARC-693) CHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR 1972. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 197p. Dep. NTIS (U. S. Sales Only) $12.00.

The three sections of this report were abstracted and indexed separately for NSA. (LK)

For abstracts of individual sections see: 24026, 24585, and 24671.

24026 (BARC-693, pp 31-129) RADIATION CHEMISTRY SECTION. 1973.

The "know how" for the manufacture of gas chromatographic accessories such as the T. C. detector, E. C. detector, pyrolyzer and gas sampling valve was released to industry. An automatic preparative gas chromatograph working on repeat cycle principle was designed and fabricated. The instrument can be programmed to automatically inject the sample and collect any five separated components. A portable hydrogen monitor was developed for the Defence Ministry. In order to produce biodegradable detergents through the hydrolysis of alkyl sulfonylchloride, a hydrocarbon mixture was sulfochlorinated under the influence of γ-radiation in 5 kg lots, in PANBIT facility. The results were quite encouraging. Terylene fibers and cloth have been grafted with acrylic acid under radiation and the resulting products have shown remarkably good dyeing properties and moisture uptake. An interesting observation was made in the case of radiation damage caused by iodine or bromine undergoing nuclear reactions of the type (n, 2n), (I. T.) and β-decay wherein the scavenger I_2 or Br_2 consumption has been estimated per nuclear event. The results show that except in the case of β-decay, a surprisingly large number ($\sim 10^6$) of molecules of the scavenger are consumed per nuclear event. In the field of ion exchange studies, the thermodynamic theory of ion exchange equilibria in nonaqueous solvents reported previously was experimentally verified for the first time. The change of medium from water to water-methanol mixture in lithium isotope studies in ion exchange equilibria resulted in a reversal of the isotope effect. Transport, activation, and redeposition of corrosion products in the recirculation and the clean-up loop systems of the Tarapur Atomic Power Station was hindering the regular and shut down maintenance jobs. In order to examine the possibility of chemical decontamination both laboratory and on-site experiments were carried out in collaboration with Desalination and Effluent Engineering Division. Preliminary experiments with a valved-out test section in TAPS established the feasibility of achieving chemical decontamination. The initial Water Chemistry in RAPP-1 prior to and after criticality was closely observed and the data were analyzed. Opportunity was also taken during this period to observe the addition and removal of boric acid to the moderator system. In a joint program with the Metallurgy and the Reactor Operations Divisions the hot conditioning of the primary heat transport system of RAPP was followed by chemical and metallurgical evaluation of coupons especially installed for that purpose. In order to keep a close watch on material compatibility, the composition of crud samples from the primary heat transport was evaluated by several techniques. (auth)

24027 (CEA-CONF-2326) SEMI-INDUSTRIAL PRODUCTION AND PROPERTIES OF HYDROPHILIZED SYNTHETIC TEXTILES RESULTING FROM A RADIOCHEMICAL TREATMENT. Gaussens, G.; Lemaire, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 12 Mar 1973. 37p. (In French). (CONF-730343-5). Dep. NTIS (U. S. Sales Only) $4.00.

From meeting on the development of industrial applications of radiation chemistry; Paris, France (13 Mar 1973).

A procedure permitting the preparation of hydrophilized synthetic textile by continuous grafting under an electron beam is described. The irradiation conditions show a very favorable effect of the distribution of the dose rates because of the self-accelerated character of the grafting reaction. The conversion curves obtained have a strongly self-accelerated character, which tends then to be slowed down. The semi-industrial operation of the pilot plant made it possible to show that the grafting rate of 7 to 9% of acrylic acid on polyester, according to the dose rate, can be obtained for a 1-Mrad dose. Examination by transmission electron microscope of sections of grafted and dyed fibers shows a ring distribution of the grafting. This privileged distribution explains the physical and chemical properties of the polyester and polyamide fabrics. These properties are examined. (tr-auth)

24028 (CEA-CONF-2327) OPTIMIZATION OF COMPOSITIONS THAT CAN BE HARDENED BY RADIATION FOR DIFFERENT PAINT SUPPORTS. Gaussens, G.; Duchemin, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 6 Apr 1973. 26p. (In French). (CONF-730343-4). Dep. NTIS (U. S. Sales Only) $3.50.

From meeting on the development of industrial applications of radiation chemistry; Paris, France (13 Mar 1973).

The limitation of the atmospheric pollution and the increase of the treatment tempo cause the electron processing of varnishes and paints to be a procedure that is becoming more and more attractive on the technical and economic plane. The availability of a large range of varnish and paint compositions that can be hardened by radiation and the flexibility of the procedure that can treat pigmented and non-pigmented coatings shows the importance of the progress made in the last several years. Two families of polymers that can be hardened by radiation are presented: acrylic and epoxy-acrylic polymers. The optimization of a formulation requires the knowledge of numerous parameters among which are the dose, reactivity of the polymer, chemical nature of the monomer, dose rate, and atmosphere during irradiation. The performances of the radioreticulated coatings obtained from monomer-acrylic polymer mixtures and monomer-epoxy-acrylic polyer mixtures are given. These mixtures make it possible to obtain a complete range of coatings with different physical and chemical characteristics that are adjustable as a function of the purpose sought. (tr-auth)

24029 (COO-3435-15) MICROWAVE-OPTICAL DOUBLE RESONANCE SPECTROSCOPY. Progress Report, February 1, 1973-January 31, 1974. Pratt, D. W. (Pittsburgh Univ., Pa. (USA). Dept. of Chemistry). 1 Nov 1973. Contract AT(11-1)-3435. 25p. Dep. NTIS $3.25.

Significant advances in the application of microwave-optical double resonance (MODR) techniques to the study of the structural properties of the phosphorescent triplet states of organic molecules were made. Results are reported of the application of such techniques to a variety of prototype triplet states including 1,4-dihalobenzenes, 1,2,4,5-tetrahalobenzenes, naphthalene and its halogenated derivatives, and benzophenone and several of its derivatives. In addition, measurements of the magnetic field dependence of the phosphorescence lifetimes of 1,2,4,5-tetrahalobenzenes in durene are reported, and it is shown how this information can be used to determine the field dependence of electron spin lattice relaxation times in the absence of microwaves. The adamantane matrix technique has been used for preparing a wide variety of free radicals (by x-irradiation) and for obtaining their EPR, optical absorption and emission spectra. Classes of radicals investigated include alkyl, 2-alkanonyl, allyl, and aromatic free radicals, and the information obtained from these studies includes (1) a quantitative assessment of the role of resonance stabilization in 2-alkanonyl radicals, (2) values of the kinetic and thermodynamic parameters governing both hindered rotation and ring conformational interconversions in well over fifty different free radicals whose EPR spectra are reported for the first time, (3) the ^{13}C and ^{17}O hyperfine splitting constants of a number of these species and (4) the room temperature optical emission and absorption spectra of several free radicals. (auth)

24030 (RRL-3238-469) QUARTERLY REPORT, OCTOBER 1, 1973-DECEMBER 31, 1973. (Mellon Inst. of Science, Pittsburgh (USA). Radiation Research Labs.). 21 Jan 1974. Contract AT(11-1)-3238. 18p. Dep. NTIS $3.00.

Abstracts of reports issued during the report period are presented as well as summaries of other investigations in progress. These investigations include ESR study of sulfur-containing alkyl radicals in aqueous solution; pulse radiolysis study of pyridinyl radicals; absorption spectrum of the cyclohexyl radical; oxidation of hydroxycyclohexadienyl radical by metals ions; a radioactivity detector applied to aqueous liquid chromatography; and micellar effect on excited singlet states. (DHM)

24031 ESR AND ENDOR STUDIES OF THE MAIN RADICAL CREATED BY GAMMA IRRADIATION AT 300 °K IN THE IMIDAZOLE CRYSTAL. Lamotte, B.; Gloux, P. (Département de Recherche Fondamentale, Section de Résonance Magnétique, Centre d'Etudes Nucléaires de Grenoble, B. P. 85-Centre de Tri 38041, Grenoble-Cedex, France). J. Chem. Phys. 59: No. 6, 3365-3377 (15 Sept 1973).

ESR studies of room-temperature gamma irradiated single crystals of imidazole and of its derivatives deuterated in several different positions have permitted us to identify the main radical produced by such irradiation. It is a π radical formed by the addition of one hydrogen atom on a carbon of the ring. Moreover, we show that the hydrogen atom which is added to form the radical comes from hydrogens involved in the hydrogen bond chains. The subsequent ENDOR study enables us to deduce the spin density distribution in the radical from the determination of all the proton hyperfine tensors. (auth)

24032 OBSERVATION OF AN ELECTRON TRANSFER PROCESS. Budzinski, E.E.; Lilga, K.T.; Box, H.C. (Department of Biophysics, Roswell Park Memorial Institute, Buffalo, New York 14203). J. Chem. Phys. 59: No. 6, 2899-2901 (15 Sept 1973).

Electron transfer has been observed by ESR spectroscopy in x-irradiated single crystals of partially deuterated glycine hydrochloride. The crystals were irradiated at 4.2 °K and the transfer occurs on warming to 77 °K. It consists of the movement of electrons between carboxyl groups with the electrons exhibiting greater affinity for protonated carboxyl groups than for deuterated carboxyl groups. A slight perturbation of β-proton hyperfine couplings in carboxyl anion radicals due to substitution of a deuteron for a proton on the carboxyl group was also observed. The shift in coupling, which amounts to a fraction of a megahertz, was measured by ENDOR spectroscopy. (auth)

24033 ENDOR OF V_F AND V_{OH} CENTERS IN CaO. Unruh, W.P.; Chen, Y.; Abraham, M.M. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). J. Chem. Phys. 59: No. 6, 3284-3288 (15 Sept 1973).

ENDOR (electron-nuclear double resonance) studies on CaO single crystals positively identify the V_F center and resolve a discrepancy in the reported g values of the V_{OH} center. Data for the same two centers in MgO were also obtained and compared with previous work. An analysis of the anisotropic hyperfine coupling constants shows that the relative lattice relaxation for both centers is roughly the same in these hosts. As expected, no motional averaging of the anisotropic resonance spectra was observed for either center. (auth)

24034 TEMPERATURE DEPENDENCE OF METHYL GROUP TUNNELLING ROTATION FREQUENCY. Clough, S.; Hill, J. R. (Univ. of Nottingham, Eng.). J. Phys., C (London); 7: No. 1, L20-L21(7 Jan 1974).

The temperature dependence is measured from 4 to 40°K of the frequency of tunnelling rotation of methyl groups in free radicals in γ-irradiated methylmalonic acid crystals. Above 25°K, the frequency, while remaining well defined, declines sharply with increasing temperature. (auth)

24035 IMPROVEMENTS IN OR RELATING TO METHODS OF AND APPARATUS FOR EFFECTING A CHEMICAL SYNTHESIS OR OTHER REACTION UTILISING ELECTRONS IN A SELECTED ENERGY RANGE. Varey, R. H.; Andrews, J. G. (to Central Electricity Generating Board). British Patent 1,337,107. 14 Nov 1970. Filed Date 11 Aug 1969. 6p.

Reference is made to methods of synthesizing chemical compounds, or conducting other chemical reactions, under the action of electron irradiation. In the method described the apparatus used comprises a discharge tube with a cathode and an anode, and means in the discharge region between cathode and anode to produce two different plasmas, differing in electron temperature and density, adjacent to one another with a "double sheath" at the boundary between the two plasmas. A "double sheath" is a double space charge layer; it contains a voltage step such that the force exerted on the electrons is in the opposite direction to that on the ions, and the total voltage drop across the "double sheath" depends on the plasma conditions on either side. Means are provided for feeding material into, and for withdrawing reaction products from, the plasma on the anode side of the "double sheath". The two different plasmas are formed by depleting neutral and unionized atoms or molecules by means of differential pumping. The discharge conditions may be adjusted so that the electrons in the reaction zone are in a selected energy range appropriate to the required reaction. (UK)

24036 SPIN DENSITIES AND STRUCTURE OF THE RADICAL FORMED IN IRRADIATED THIODIGLYCOLIC ACID. Wells, J. W. (State Univ. Coll., Buffalo); Budzinski, E. E. J. Chem. Phys.; 59: No. 9, 5211-5212(1 Nov 1973).

The free radical formed in irradiated thiodiglycolic acid was examined by the ENDOR technique to resolve its hyperfine structure. Crystals were prepared and were measured at 4.2°K. (LK)

24037 EFFECT OF HIGH ENERGY RADIATION ON SODIUM METHYLARSONATE AND n-PROPYLARSONIC ACID STUDIED BY ELECTRON SPIN RESONANCE SPECTROSCOPY. Lyons, A.R.; Symons, M.C.R. (Department of Chemistry, The University, Leicester LE1 7RH, England). J. Chem. Phys. 60: No. 1, 164-169 (1 Jan 1974).

Exposure of Na_2MeAsO_3 and n-$PrAsO(OH)_2$ to γ rays at 77 °K gave radical species whose ESR spectra comprised sets of four lines assigned to hyperfine coupling to ^{75}As nuclei. All centers had magnetic axial symmetry. Evidence is presented in favor of the identification of the trapped species as AsO_3^{2-}, $Na^+ ... AsO_3^{2-}$, $MeAsO_3^{3-}$, $H_2CAsO_3^{2-}$ (two equivalent protons also detected) in Na_2MeAsO_3, and the species $AsO(OH)_2$, $PrAsO(OH)_2$, and, less certainly, $HAsPrO(OH)_2$ and $PrAsO_2^-$ in n-$PrAsO(OH)_2$. Structural aspects of the results are considered, and possible mechanisms for the formation of these radicals are proposed. (auth)

24038 HYDROGEN-DEUTERIUM ISOTOPE EFFECT IN THE DECAY OF RADICAL PAIRS IN X-RAY IRRADIATED HYDROXYUREA. Haven, Y.; Williams, R.C.; Hamrick, P.J. Jr.; Shields, H. (Departments of Physics and Chemistry, Wake Forest University, Winston-Salem, North Carolina 27109). J. Chem. Phys. 60: No. 1, 127-132 (1 Jan 1974).

The rate constants for the transformation of radical pairs to single radicals in x-ray irradiated hydroxyurea have been determined from the decay of ESR spectra at temperatures from 253 to 268°K. The ratio of decay rates for a protonated to a deuterated sample changes from approximately 13 in the initial stage to 5 in the later stage. The decay curves are explained by assuming that the decay is associated with a diffusion of H(D) vacancies from one radical of a pair to a neighboring molecule, dissociating the radical pair. The decay rates in the initial stage of decay for a protonated sample, $k_{11}(H)$, and for a deuterated sample, $k_{11}(D)$, may be presented as $k_{11}(H) = 1 \times 10^7 \exp[(-0.50\ eV)/kT]$, $k_{11}(D) = 6 \times 10^{11} \exp[(-0.82\ eV)/kT]$. (auth)

24039 TREATMENT OF POLYCHLORINATED BIPHENYL IN WATER BY IONIZING RADIATION. Kinoshita, S.; Sunada, T. (Radiation Center of Osaka Prefecture). pp 607-614 of Advances in Water Pollution Research. Jenkins, S. H. (ed.). Elmsford, NY; Pergamon Press, Inc. (1973).

From 6th international conference on water pollution research; Jerusalem, Israel (18 Jun 1972). See CONF-720618-.

Although a colloidal aqueous solution of polychlorinated biphenyl is destroyed by gamma radiation, its resistance to radiation is far more than other chlorinated hydrocarbons such as pentachlorophenol or pesticides such as parathion. The proposed radiation treatment involves several procedures such as irradiation, sedimentation by coagulation, filtration, and postchlorination. (LK)

24040 REDOX POTENTIALS OF FREE RADICALS. I. Simple Organic Radicals. Rao, P. S.; Hayon, E. (Army Natick Labs., MA). J. Amer. Chem. Soc.; 96: No. 5, 1287-1294(6 Mar 1974).

The redox potentials of some free radicals in aqueous solution have been determined using a new method. This method is described in detail and is based on the electron transfer properties and characteristics of the donor radical ·RH to a range of acceptor molecules A. The reaction $\cdot RH + A \rightleftharpoons R + \cdot A^- + H^+$ occurs at an appreciable rate whenever the redox potential $E^{\circ\prime}$ (V, at pH 7.0, ~25°) of A is higher than that of ·RH. The percentage efficiency of this electron transfer process is determined for a large number of acceptors by monitoring the formation of the $\cdot A^-$ radicals at the appropriate pH and wavelength. The fast reaction technique of pulse radiolysis and kinetic absorption spectrophotometry has been used to follow these reactions. Typical "titration" type curves are obtained when plotting the percentage efficiency vs $E^{\circ\prime}$ of the acceptors. From the midpoint of such curves, the redox potentials of a number of organic free radicals have been determined. Various radicals derived from aliphatic alcohols, sugars, lactic acid, glycolic acid, lactamide, glycolamide, oxalacetic acid, glycine, and glycine anhydride have been produced and their potentials derived. These radicals are known to undergo acid-base reactions, and the variations of the $E^{\circ\prime}$ as a function of the acid or base forms of the radicals were studied. In all cases, the ionized (basic) forms of the radicals have significantly lower redox potentials than the acid forms of the radicals, making these radicals more powerful reducing agents. Some aspects of the mechanisms and kinetics of free radical reactions in the literature are discussed and can be rationalized on the basis of the determined redox potentials of these free radicals. (auth)

24041 REDOX POTENTIALS OF FREE RADICALS. II. Pyrimidine Bases. Rao, P. S.; Hayon, E. (Army Natick Labs., MA). J. Amer. Chem. Soc.; 96: No. 5, 1295-1300(6 Mar 1974).

The technique of pulse radiolysis and kinetic absorption spectrophotometry was used to determine the redox potentials ($E^{\circ\prime}$) of various pyrimidine radicals (·RH) in aqueous solutions. The method used to derive the potentials of these free radicals is based on the electron transfer properties of these radicals to a range of acceptor molecules A, whose redox potentials are known, $\cdot RH + A \rightleftharpoons R + \cdot A^- + H^+$. The intermediates produced from the reaction of OH radicals with thymine, uracil, 1-methyluracil, 1,3-dimethyluracil, cytosine, dihydrothymine, and dihydrouracil were studied. These give characteristic $E^{\circ\prime}$ values of ~+0.13 V at pH 7.0. In alkaline solutions, beyond the pK_a^1 of these pyrimidines, the "enol form," of these intermediates have significantly lower (more negative) potentials, making these radicals stronger reducing agents. The intermediates produced from dihydropyrimidines at pH 7.0, however, have $E^{\circ 1} = \sim -0.20$ V. The electron adducts to these pyrimidines produce ketyl-type radicals, and these have been found to have very low oxidation potentials, $E^{\circ 1} = -1.3$ V, making these radicals powerful reducing agents. The implications of these results are discussed. The reaction rate constants of some of these electron transfer processes have been measured and are found to be $\leq 5 \times 10^{-9}\ M^{-1}\ sec^{-1}$ for acceptors whose redox potentials are more positive than those of the donor radicals. (auth)

24042 HYDRATED ELECTRON. Hart, E. J.; Anbar, M. New York; John Wiley and Sons, Inc. (1970). 276p.

Topics covered are: the hydrated electron as a chemical species, early developments; physical properties; reactions with water dissociation and ionization products; reactions of inorganic compounds, reactions of organic compounds; reactions with constituents of biological systems; mechanisms of reaction; and methods. The Appendix contains properties of the hydrated electron, factors and dose rate dependence of Fricke dosimeters, dose distribution in water at different electron energies, Van Slyke factors, reactions and rate constants of irradiated H_2O and D_2O, tables for the evaluation of simultaneous first- and second-order decay curves, and hydrated electron rate constants. (LK)

24043 EFFECT OF IONIZING RADIATION ON HYDROCARBONS AND POLYETHYLENE IN THEIR CRYSTALLINE STATE. Patel, G. N.; Keller, A. (Univ. of Bristol, Eng.). J. Polym. Sci., Polym. Lett. Ed.; 11: No. 12, 739-743(Dec 1973).

Polyethylene, dicarboxylic acids, and the paraffin n-$C_{36}H_{74}$ were irradiated with $^{60}Co\ \gamma$ rays and were studied for cross-linking, double bonds, and chain scission. No cross-links occurred within the paraffinoid lattice up to doses of 600 Mrads. In nonpolymeric hydrocarbon crystals, the cross-links link chains at their ends, and in chain-folded polyethylene they are situated exclusively within the fold surface and may form links either in the fold region of the same molecule or between folds of other molecules. Transvinylene double bonds are uniformly distributed within the crystalline lattice, but there is a reduced concentration of such double bonds within the fold region of polyethylene. There is no chain scission within the paraffinoid lattice and by existing results there is no reason for invoking chain scission, even in the composite amorphous-crystalline system of chain-folded polyethylene. (LK)

24044 RADIOCHEMICAL COPOLYMERIZATION OF ACRYLIC ACID-N-VINYLCARBAZOLE MIXTURES IN THE SOLID STATE. Mankowski, Z. (CNRS, Meudon, France). J. Chim. Phys.; 70: No. 9, 1299-1304(Sep 1973). (In French).

The copolymerization of two polar vinyl monomers in the solid state exposed to γ radiation was studied. Strong interactions were observed between acrylic acid molecules and N-vinyl carbazole with the probable formation of a vitreous molecular complex. It is likely that this complex favors the propagation of macromolecular chains and the formation of an alternating structured copolymer. It is also probable that a homogeneous equimolar mixture of monomers leads predominantly to the alternating structured copolymer. (FR)

24045 ROLE OF N_2^+ IN THE FORMATION OF CN RADICALS BY PULSE RADIOLYSIS OF THE $CH_4 + N_2$ RARE GAS MIXTURE. Schmidt, M.; Clerc, M. (CEN de Saclay, Gif-sur-Yvette, France). J. Chim. Phys.; 70: No. 9, 1214-1220(Sep 1973). (In French).

The formation of CN radicals in $CH_4 + N_2$ mixtures was studied using flash radiolysis with 560-keV 3-ns electron pulses, a time resolution of 10 ns being obtained. Emission and absorption techniques were used to observe the kinetics of the occurrence and disappearance of CN_2, NH, and CH radicals as well as the effect of adding rare gases on the intensity of these emissions. The radiative lifetimes of CH $A^2\Delta(RO - 0, k = 1)$, $B^2\Sigma(Q0 - 0)$, and $C^2\Sigma(0 - 0)$ states were measured and found equal to 575 ± 25 ns, 550 ± 50 ns, and 54 ± 5 ns. It was concluded that in $CH_4 + N_2$ mixtures, the formation of CN is linked to that of the N_2^+ ion and to its dissociative recombination with thermalized electrons yielding nitrogen atoms. (FR)

24046 EPR OF RADICALS IN γ-IRRADIATED DURENE. 3. Isomerizations of Tetramethylcyclohexadienyl Radical. Monge, J. L.; Schott, M. (Ecole Normale Superieure, Paris). J. Chim. Phys.; 70: No. 10, 1555-1557(Oct 1973).

After γ-irradiation of crystalline Durene at 300°K, two radicals are initially present, among others: tetramethylcyclohexadienyl (radical II) and 2.4.5-trimethylbenzyl (radical III). Radical II disappears either slowly in the dark at 300°K, or in a few minutes after illumination in its first doublet absorption band near 550 nm, the end product of the process being radical X, which is also present in the EPR spectrum just after irradiation at 300°K. The identification of radical X as pentamethylcyclopentadienyl is presented. It is shown that the reaction proceeds by two isomerization processes through an intermediate bicyclic radical, at least after absorption of a 550 nm photon. (FR)

24047 EFFECT OF GAMMA RADIATION ON PURE PARAFFIN WAX AND ON WAX–ACETONE SYSTEM. Mayahi, M. F.; Mousa, M. M. (College of Science, Baghdad). J. Indian Chem. Soc.; 49: No. 10, 981-984(1972).

The structure of Iraqi paraffin wax is straight chain with no branching or unsaturation, with an average formula of $C_{34}H_{70}$ and an average molecular weight of 471. The effect of gamma radiation on pure wax is to give degradation products containing some unsaturation. Crosslinking of these fragments, which occurs at 60 Mrads, gives products of molecular weight less than twice the original. The effect on wax-acetone system is that no degradation or crosslinking is observed using up to 115.2 Mrads. Thus there is complete protection by acetone. (Indian Sci. Abstr.)

24048 RADIATION CHEMISTRY OF BENZENE AND CYCLOHEXANE. Rai, R. S. (Bhabha Inst. of Tech. and Science, Pilani, India). Vishwakarma; 13: No. 6, 23-31(1972).

Chemical effects of high energy gamma radiation on benzene and cyclohexane in the liquid state are presented in detail to elucidate the mechanism of energy transfer process in radiation chemistry. In the early stages, the energy transfer is confined to radiation protection, sensitized luminescence, and quenching phenomenon. The secondary processes lead to sensitized decomposition of organic liquid and related systems and finally the reaction of excited species follows. The process of energy deposition, energy localization, and excitation is based on some physical and chemical processes. The corrected G values for some sensitized decomposition products are presented, characterization of radiolysis is discussed, and comments are made on kinetic and mechanistic analysis of the radiation chemistry of benzene and cyclohexane in the liquid phase. (Indian Sci. Abstr.)

24049 RADIATION CHEMISTRY OF CARBOHYDRATES. IV. γ-Radiolysis of Cellobiose in N_2O Saturated Aqueous Solution. Part I. Identification of the Products. Dizdaroglu, M.; von Sonntag, C. (Max-Planck-Institut fuer Kohlenforschung, Muehlheim an der Ruhr, Ger.). Z. Naturforsch.; 28b: No. 9/10, 635-646(Oct 1973). (In German).

After γ-radiolysis of N_2O-saturated deoxygenated aqueous solutions of cellobiose (10^{-2}M) the products were determined. Analytical techniques were column chromatography, thin-layer chromatography, and gas-liquid chromatography combined with mass spectroscopy. (GE)

24050 RADICALS FORMED DURING THE RADIOLYSIS OF A RANGE OF OXYSULFUR AND OXYPHOSPHORUS COMPOUNDS. Mishra, S. P.; Rao, K. V. S.; Symons, M. C. R. (Univ. of Leicester, Eng.). J. Phys. Chem.; 78: No. 6, 576-583(14 Mar 1974).

Exposure of the following compounds, both pure and in various solvents, to $^{60}Co\ \gamma$ rays at 77°K gave ESR spectra that have been interpreted in terms of the radicals indicated in parentheses, either directly, or after annealing: chlorosulfonic acid ($H\dot{S}O_3$, $H\dot{S}O_3Cl^-$, $\dot{O}_3SCl$, $O\dot{S}(OH)Cl^+$); thiophosphoryl chloride ($SPCl_3^-$, $SPCl_2$, $SPCl_3^+$); thionyl chloride ($O\dot{S}Cl_2^-$, $Cl\dot{S}O_2$); and sulfur chloride ($\dot{S}_2Cl_2^-$). In addition, thiophosphoryl bromide gave $S\dot{P}Br_3^-$ and $S\dot{P}Br_2$ radicals. The mechanisms of the reactions involved and the structures of the radicals are discussed. Attention is drawn to the observation of two species with properties characteristic of $\dot{P}X_4$ radicals formed from thiophosphoryl chloride in glassy methanol. One, which had only one strongly interacting chloride ligand, gave way to the more stable, with two strongly interacting chloride ligands, on slight warming. It is suggested that the former is the thermodynamically unstable isomer of $S\dot{P}Cl_3^-$ having sulfur and chloride in the axial positions rather than two chloride ligands. (auth)

24051 KINETICS OF DECAY OF HYDROXYL RADICALS AT LOW PRESSURE. McKenzie, A.; Mulcahy, M. F. R.; Steven, J. R. (CSIRO, North Ryde, Australia). J. Chem. Phys.; 59: No. 6, 3244-3254(15 Sep 1973).

The kinetics of decay of OH radicals in excess He at 298°K and about 1 torr pressure have been studied in a flow tube by ESR spectrometry and computer simulation. In agreement with previous work [Breen and Glass, J. Chem. Phys. 52, 1082 (1970); Mulcahy and Smith, J. Chem. Phys. 54, 5215 (1971)], a first-order reaction of OH at the surface was found to accompany the gas-phase reactions $OH + OH \rightarrow H_2O + O$ and $OH + O \rightarrow O_2 + H$. When [OH] is about 10^{-10} mole cm^{-3} or less, the rate of the heterogeneous reaction can be comparable with that of the homogeneous reaction. After allowing for the effects of diffusion resistance on the radial concentration profile, the nonsteady state concentration of O atoms, and the difficulties associated with accurate kinetic analysis of a system of simultaneous first and second order reactions, the rate constant for $OH + OH \rightarrow H_2O + O$ was found to be $k_2 = (1.3 \pm 0.3) \times 10^{12}\ cm^3\ mole^{-1} \cdot sec^{-1}$. (auth)

24052 EFFECTS OF GAMMA IRRADIATION ON THE FUNCTION AND CONFORMATION OF RIBONUCLEASE A IN DILUTE

SOLUTION. Rokushika, S. (Kyoto Univ.). Radiat. Res.; 57: No. 2, 349-357(Feb 1974).

Bovine pancreatic ribonuclease A (EC 2.7.7.16) in aqueous solutions has been exposed to γ irradiation, and several properties of the irradiated enzyme molecule were examined. Kinetic and thermodynamic parameters of RNase A were not affected even when the enzymatic activity was considerably lost by γ irradiation. While the structural changes of the irradiated RNase A were detected, $[m']_{233}$ values gradually decreased with increasing dose. The accessibility of tyrosyl and histidyl residues in the enzyme molecule for a chemical reagent was greatly increased in relatively lower dose ranges. All six tyrosyl residues were diazotized with DHT when 70% of enzymatic activity was still retained. 2'-Cytidilate-binding capacity and enzymatic activity of RNase A were reduced depending on the increase of dose at somewhat different rates. Decrease of the heat of denaturation also indicates that the local conformation change of the enzymes through γ irradiation precedes the disappearance of the enzymatic activity. (auth)

24053 RADIOLYSIS OF AN ALKALINE PHOSPHATASE. Lynn, K. R.; Skinner, W. J. (National Research Council of Canada, Ottawa). Radiat. Res.; 57: No. 2, 358-363(Feb 1974).

Nonexponential losses of activity in alkaline phosphatase were observed with four substrates after γ-irradiation. Those losses were at the same rates for each of the combinations of radicals generated in water under O_2, N_2, and N_2O. However, the compositions of the radiolysed proteins varied depending on the gaseous atmosphere used. The enzyme retained a high proportion of its activity even when extensive radiolytic damage to its component residues was found. These data suggest that radical attack on the phosphatase was at centers of secondary importance for the enzymatic activity. (auth)

24054 EFFECT OF MIXING ON NONUNIFORMLY INITIATED POLYMERIZATION BY RADIATION. Kawakami, W.; Machi, S. (Japan Atomic Energy Research Inst., Takasaki). A.I.Ch.E. (Amer. Inst. Chem. Eng.) J.; 19: No. 1, 94-101(Jan 1973).

An analytical study was carried out on the effects of mixing on radioinduced polymerization in which the species initiating the polymerization were not uniformly produced because of a nonuniform dose rate distribution. The analysis is based on the periodic irradiation of fluid elements circulating in a stirred-tank reactor having a high dose rate region and a very low dose rate region. It is shown that the rate of polymerization increases with agitation speed and that the bimodal molecular weight distribution of the polymer formed at low agitation speed moves to a unimodal distribution as the agitation speed increases. (auth)

24055 USE OF THE METHOD OF SCRATCHING IN THE EVALUATION OF RADIATION EFFECTS. Boyarskaya, Yu. S.; Zhitaru, R. P.; Shutova, S. S. (Inst. of Applied Mechanics, Kishinev, USSR). Ind. Lab. (USSR) (Engl. Transl.); 39: No. 2, 276-279(Feb 1973).

Translated from Zavod. Lab.; 39: No. 2, 193-197(Feb 1973).

Scratching and indentation were used to evaluate radiation effects on NaCl crystals. The results indicate that for assessing the radiation strengthening of crystals (i.e., of the increase in the resistance to plastic strain) better results are obtained by the indentation than by the scratching method. However, scratching enables detection and evaluation of the increased crystal brittleness due to radiation. Both methods should be used for a complete evaluation of the radiation effect. (LK)

Radiochemistry and Nuclear Chemistry

Hot-Atom Chemistry

Refer also to abstracts 24026 and 25158.

24056 CHEMICAL EFFECTS OF THE $^{37}Cl(n,\gamma)^{38}Cl$ REACTION ON GASEOUS CARBON TETRACHLORIDE. Mudra, K. (Ustav Jaderneho Vyzkumu, Rez, Czech). Radiochim. Acta; 19: No. 1, 16-22(1973).

Chemical reactions of hot recoil chlorine atoms with carbon tetrachloride were studied. Gaseous mixtures of carbon tetrachloride, moderator (argon) and scavengers (I_2 and C_2H_4) at a total pressure of 83 torr were irradiated in a reactor. Analysis of products was made using standard radio-gas chromatography technique, followed by counting of frozen species in a well-type scintillation counter, connected to a multichannel pulse height analyzer. The dependence of product yield on the percentage of ethylene present in the reaction mixture was determined. Hot chlorine replacement reactions yielding the labelled $CCl_3{}^{38}Cl$ and $CCl_2{}^{38}Cl$ were found. The chlorine abstraction reaction was observed by means of the subsequent reaction of labelled $Cl^{38}Cl$ with ethylene to form $C_2H_4Cl^{38}Cl$. Detailed studies of the effect of argon moderator on $^{38}Cl + CCl_4$ system were made. The data obtained were analyzed by means of the kinetic theory of hot reactions and then compared with similar results, obtained previously on $T + CH_4$ and $F + CF_4$ systems. (GE)

24057 ION-MOLECULE REACTIONS FOLLOWING β-DECAY OF TRITIATED CYCLOBUTANE AND CYCLOPENTANE. Pobo, L. G. (Argonne National Lab., IL); Wexler, S.; Caronna, S. Radiochim. Acta; 19: No. 1, 5-9(1973).

Ion-molecule reactions of daughter species from β-decay of tritiated cyclobutane and cyclopentane were studied by ion cyclotron resonance spectroscopy. Single and double-resonance experiments on tritium-labelled cyclobutane showed that the principal reactions are hydride and tritide transfer, and a condensation reaction involving $C_4H_nT_m^+(n + m = 7)$ giving $C_6H_nT_m^+(n + m = 9)$. Single-resonance data on tritiated cyclopentane gave evidence for only the $C_5H_nT_m^+(n + m = 9) \rightarrow C_6H_nT_m^+(n + m = 9)$ condensation reaction. (GE)

24058 CLASSICAL TRAJECTORY STUDY OF BOND ENERGY EFFECTS. Chapman, S.; Suplinskas, R.J. (Department of Chemistry, Yale University, New Haven, Connecticut 06520). J. Chem. Phys. 60: No. 1, 248-257 (1 Jan 1974).

Three body classical trajectory calculations are used to investigate bond energy effects in the hot atom reactions of tritium atom with a series of hydrocarbons. The surface for $T + CH_3{-}H$ is a modification of that used by Polanyi and co-workers. The hydrocarbon series is represented by changing the bond dissociation energy, bond length, and mass only. Other potential parameters are fixed. It is found that the experimental ratios of abstraction yields are reproduced quite well theoretically at the single tritium atom energy of 2.8 eV. Of the parameters varied, only the bond dissociation energy had a significant effect on the abstraction ratios. These results lead us to support the high energy model for these effects. (auth)

24059 ORIGIN OF BOND ENERGY EFFECTS IN HOT ATOM CHEMISTRY. Chapman, S.; Valencich, T.; Bunker, D.L. (Department of Chemistry, University of California, Irvine, California 92664). J. Chem. Phys. 60: No. 1, 329-330 (1 Jan 1974).

Six-particle $T+CD_4$ trajectory studies show that bond energy effects on H abstraction, previously explored with a 3-particle LEPS potential, arise from correlation of barrier height with exoergicity. (AIP)

24060 RADIATION DEFECTS GENERATED BY THE (n,γ) REACTION IN TIN CHALCOGENIDES. Seregin, P. P.; Savin, E. P. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Solid State (Engl. Transl.); 15: No. 3, 541-542(Sep 1973).

Translated from Fiz. Tverd. Tela; 15: No. 3, 777-780(Mar 1973).

The emission gamma-resonance spectroscopy of the ^{119m}Sn nuclei was used to study the influence of the capture of thermal neutrons on the stabilization of Moessbauer atoms. It was found that the reaction $^{118}Sn(n,\gamma)^{119}Sn$ in divalent tin chalcogenides failed to produce new states of tin atoms: The majority (~100%) of the tin recoil atoms was stabilized at normal lattice sites. This was due to the low recoil energy in the investigated reaction. Results were used to explain certain features of the Moessbauer spectra of the compounds of ^{118}Sn irradiated in nuclear reactors. (auth)

24061 COMPARATIVE STUDY OF RETENTION OF ^{56}Mn IN SOLID PERMANGANATES IN (n,γ) AND (d,p) REACTIONS. Oblivantsev, A. N.; Kulikov, N. F. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 139-141(1973).

Translated from Radiokhimiya; 15: No. 1, 136-139(1973).

The retention of ^{56}Mn in solid potassium, rubidium, and cesium permanganates in irradiation with deuterons is less than in irradiation with neutrons and increases in the series of permanganates from potassium to cesium. The relation of the retention to the nature of the cation is preserved after isothermal annealing. In the system $KMnO_4-DClO_4$ the retention on irradiation with neutrons increases monotonically with the increase in the Debye temperature of the crystals. (auth)

24062 HOT HYDROGEN ATOM-HYDROCARBON REACTIONS. Dependence of Yields on Structure and Energy. Compton, L. E.; Beverly, G. D.; Martin, R. M. (Univ. of California, Santa Barbara). J. Phys. Chem.; 78: No. 6, 559-567(14 Mar 1974).

The hot atom reactions of H atoms with C_2D_6, C_3D_8, and $n-C_4D_{10}$, and D atoms with C_2H_6, C_3H_8, $n-C_4H_{10}$, and $n-C_6H_{14}$ have been studied over the hot atom initial energy range 1.1-2.9 eV, using HBr and DBr as photochemical sources. The steady-state treatment provides a consistent description of the data, giving ratios of the hot atom rate coefficients k_R/k_T, k_R/k_t, and k_M/k_t, where k_R is the hydrocarbon reaction coefficient, k_M the hydrocarbon moderation coefficient, k_t the hydrogen halide total interaction coefficient, and $k_T = k_R + k_M$. The integral reaction probability k_R/k_T is found to increase monotonically with energy for all systems, and increases strongly with n for the C_n compounds studied. k_R/k_t has a similar dependence on hydrocarbon structure, and a similar dependence on energy for the DBr–RH systems, but is nearly energy independent for the HBr–RD systems. k_M/k_t shows more variable behavior than the two k_R functions, but is approximately the same for different C_n compounds, and in general decreases about 50% for HBr–RD and 20% for DRr–RH from 1.1 to 2.9 eV, with an increase at intermediate energies for the DBr–RH systems. At 2.9 eV the k_M/k_t values are within 0.8 ± 0.1 for HBr–RD and 1.2 ± 0.1 for DBr–RH. The k_R/k_t values increase at this energy by half the C_2 value with each increase in n, and $(k_R/k_t)_{DBr-RH} = 4.8(k_R/k_t)_{HBr-RD}$. For HBr at 2.9 eV and HI at 185 nm (3.3 – 3.6 eV), $(k_t)_{HI}/(k_t)_{HBr}$ is only weakly dependent on the RD compound, with values in the range 1.7 – 2.0 from the k_R/k_t data and 1.8 – 2.1 from the k_M/k_t data. An average per bond yield formula is found to fit the integral reaction probability data in the 2 – 3 eV region, giving a secondary to primary bond yield ratio, Y_s/Y_p, of 2.4 – 2.6 for the C_2–C_4 cases. The composite isotope effect, $(k_R/k_T)_{D-RH}/(k_R/k_T)_{H-RD}$, is within 2.2 ± 0.3 for the C_2–C_4 hydrocarbons for initial hot atom energies of 1.1, 1.6, and 2.9 eV, and is consistent with the effect expected from inertial considerations. In general, it appears that the relative hot atom reaction yields in different RH compounds or RD compounds are primarily due to reactive effects rather than moderation effects (i.e., to large differences in the primary and secondary bond reactivities). (auth)

Properties of Radioactive Materials

Refer also to abstracts 23988, 24544, 24568, and 24570.

24063 (BARC-676) MOLTEN SALT CHEMISTRY. Part III. Solubility of PuF_3 in Molten Mixtures of LiF–BeF_2–ThF_4 and LiF–ThF_4. Iyer, P. N.; Prasad, R.; Vaidya, V. N.; Roy, K. N.; Singh, Z.; Sood, D. D.; Ramaniah, M. V.; Srinivasan, N. (Bhabha Atomic Research Centre, Bombay (India). Radiochemistry Div.). 1973. 37p. Dep. NTIS (U. S. Sales Only) $4.00.

The solubility of PuF_3 was determined in the temperature range 500 to 800°C in the ternary mixture of LiF–BeF_2–ThF_4 of the compositions of relevance to the molten salt breeder reactor concept. Filtered samples of the molten fluoride, that was saturated with PuF_3, were withdrawn and the plutonium in these samples was estimated by potentiometric and radiochemical methods. The data could be represented by straight lines in log (solubility) vs 1/T plots, the slopes of which give the heat of solution. The solubility values lie between 0.82 m/o at the temperature of 550°C to 5.45 m/o at 750°C indicating that PuF_3 is sufficiently soluble to fuel a molten salt reactor with plutonium. The solubility of PuF_3 in binary mixtures of LiF–ThF_4 in which the ThF_4 composition was varied from 20 to 35 m/o was determined. The solubility of PuF_3 did not show appreciable variation at a given temperature within the ThF_4 concentration range studied. (auth)

24064 (BAW-4228-3) RESEARCH AND DEVELOPMENT PROGRAMS ON PLUTONIUM FUELS TECHNOLOGY. Report No. 3. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Research and Development Div.). Dec 1973. Contract AT(11-1)-3111. 7p. Dep. NTIS $4.00.

Plutonium R&D programs were at a low level during this period. The three areas of activity are scrap recovery, Gel-Addition studies and plutonium critical experiments. The scrap recovery campaign and the Gel-Addition project were concluded. A series of critical experiments on plutonium fuel was conducted under the Plutonium Utilization Program. (auth)

24065 (BNL-18435) CHEMISTRY OF TECHNETIUM AS IT IS APPLIED TO RADIOPHARMACEUTICALS. Richards, P.; Steigman, J. (Brookhaven National Lab., Upton, N.Y. (USA); State Univ. of New York, Brooklyn (USA). Downstate Medical Center). 1973. 36p. (CONF-740203-5). Dep. NTIS $4.00.

From international symposium on radiopharmaceuticals; Atlanta, Georgia, USA (12 Feb 1974).

The chemistry of ^{99m}Tc, used as a tracer in medicine, is discussed. Study of the chemistry of this element should lead to a better understanding of the use of radiopharmaceuticals that contain it and to a more rapid development of additional useful formulations. The mechanism of labeling human serum albumin with ^{99m}Tc is discussed. (LK)

24066 PHASE DIAGRAM OF THE SYSTEM NaCl–KCl–UCl_4. Desyatinik, V. N.; Dubinin, B. V.; Raspopin, S. P. J. Appl. Chem. USSR (Engl. Transl.); 46: No. 8, 1953-1954(Aug 1973).

Translated from Zh. Prikl. Khim.; 46: No. 8, 1840-1841(Aug 1973).

A study of the interaction of UCl_4 with the chlorides of sodium and potassium is reported. The system NaCl–KCl–UCl_4 has two eutectic points and one peritectic and includes compositions of low melting points, which can be used as electrolytes for electrochemical production of uranium. (LK)

24067 STUDIES ON THE SULFATE COMPLEXING OF TETRAVALENT ACTINIDES. Patil, S. K.; Ramakrishna, V. V. (Bhabha Atomic Research Centre, Bombay). Radiochim. Acta; 19: No. 1, 27-30(1973).

The complex formation of Np(IV) and Pu(IV) with sulphate ions was studied in perchloric–sulphuric acid solutions at an ionic strength of 2.0 and $[H^+] = 2.0$ M by the distribution method employing the liquid cation exchanger dinonylnaphthalenesulphonic acid. Similar studies on Np(IV) were done using TTA extraction method also. The enthalpy and entropy changes associated with the complex formation were determined from the temperature variation of the formation constants. A comparison of the thermodynamic data for the sulphate complexing of all the tetravalent actinides was made. (GE)

24068 CHEMISTRY OF TECHNETIUM LABELING OF RADIOPHARMACEUTICALS BY ELECTROLYSIS. Steigman, J.; Eckelman, W. C.; Meinken, G.; Isaacs, H. S.; Richards, P. (Downstate Medical Center, Brooklyn). J. Nucl. Med.; 15: No. 2, 75-80(Feb 1974).

Technetium-99m labeling of albumin in dilute HCl solution in the zirconium electrolytic cell is accompanied by the reduction of pertechnetate by the zirconium anode. This is shown by the action of HF on zirconium metal which produces labeled albumin or labeled DTPA without the passage of an electric current. The action of the current in the presence of HCl is due to the disruption of a protective oxide layer on the metal. HF strips the oxide more readily by forming stable fluoride complexes, which expose the metal; the latter is a powerful reducing agent. Electrolysis of HCl without technetium produces a solution with reducing properties shown by the reduction of methylene blue. Aluminum in the presence of HF behaves like zirconium towards pertechnetate. The existence of a zirconyl pertechnetate inner complex is shown to be extremely unlikely. (auth)

24069 DIVALENT AMERICIUM IN MOLTEN SALT + MOLTEN PLUTONIUM SYSTEMS. Leary, J. A.; Mullins, L. J. (Los Alamos Scientific Lab., NM). J. Chem. Thermodyn.; 6: No. 1, 103-104(Jan 1974).

Reference is made to a publication by Ryan [J. Chem. Thermodynamics 5:153 (1973)] and to previous publications by the present authors [Leary et al., Symposium on Thermodynamics with Emphasis on Nuclear Materials and Atomic Transport in Solids, Vol. 1, International Atomic Energy Agency: Vienna. 1966, page 459; and Mullins et al., J. Inorg. Nucl. Chem. 30: 147 (1968)] concerning the valency of Am in molten salt systems. It is stated that the earlier conclusions were based on the stoichiometry of the reaction, not on thermochemical reasoning. The matter has been reviewed and reasons are given for concluding that the original interpretation, that the americium in the salt phase is preponderantly divalent, was correct. (UK)

24070 PHOSPHINE OXIDE COMPLEXES OF Th(IV), U(IV) AND DIOXOURANIUM(VI) PERCHLORATES. Bagnall, K. W.; Wakerley, M. W. (Univ. of Manchester, Eng.). J. Less-Common Metals; 35: 267-274(1974).

Complexes of thorium(IV) and uranium(IV) perchlorates, $M(ClO_4)_4.xR_3PO$ (R = Me, M = U, x = 6; R = nPr, M = Th, x ~ 4 and M = U, x ~ 5; R = Ph, M = Th, x = 5 and M = U, x = 5–6; R = Me_2N, M = Th, U, x = 6), $U(ClO_4)_4$.4ompa and the dioxouranium(VI) compounds $UO_2(ClO_4)_2.yR_3PO$ (R = Me, nPr, y = 4) were prepared. The vibrational and uv/visible spectra of these complexes are discussed. (21 references) (auth)

24071 CRYSTAL STRUCTURES OF $ThBr_4$ POLYMORPHS. Mason, J. T.; Jha, M. C.; Bailey, D. M.; Chiotti, P. (Ames Labs., IA). J. Less-Common Metals; 35: 331-338(1974).

Thorium tetrabromide has two polymorphic forms with a transformation temperature of 426 ± 5°C and a melting temperature of 678 ± 5°C. The space group symmetry of the high-temperature form, β-$ThBr_4$, was confirmed as $I4_1/amd$ by single-crystal x-ray diffraction techniques. The lattice parameters were measured as a = 8.934 ± 0.003 and c = 7.964 ± 0.001 Å. The calculated x-ray density is 5.76 g/cm^3 and the measured density is 5.70 g/cm^3. The structure of the low-temperature form, α-$ThBr_4$, has space group symmetry $I4_1/a$. A complete structure determination was made from single-crystal x-ray diffraction intensities. There are four molecules of $ThBr_4$ per unit cell. With the origin at $\bar{1}$, the thorium atoms are in set (4a) with positions 0, $^1/_4$, $^1/_8$ and the bromine atoms are in set (16f) with positions 0.3378, 0.4727, 0.1998. The lattice parameters are a = 6.737 ± 0.001 and c = 13.601 ± 0.003 Å. The calculated x-ray density is 5.94 g/cm^3 and the measured density is 5.84 g/cm^3. (5 tables) (auth)

24072 MEASUREMENT OF THE SPECIFIC ACTIVITY OF ^{14}C-LABELED BARIUM CARBONATE BY MEANS OF A 4π FLOW COUNTER. Denisikov, A. I.; Sobolev, Yu. P. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 20, 20-23(1973). (In Russian).

A method for the preparation of ^{14}C-labeled barium carbonate sources for 4π flow counters is described. A method is given for the measurement of the activity of the source with an error of about 1%. The size of the correction, caused by the absorption of β particles in the source backing and by self-radioactive materials, is reported. (tr-auth)

24073 LABELLING OF ALKYL IODIDES WITH ^{131}I BY HETEROGENEOUS ISOTOPIC EXCHANGE. Toth, G.; Jasz, A. (Inst. of Isotopes, Budapest). Int. J. Appl. Radiat. Isotop.; 25: No. 2, 95(Mar 1974).

A method of heterogeneous exchange of alkylhalides with halogens in solid-gas systems is reported where the exchange takes place between iodine, absorbed on rhodium, and alkyliodides. The labelling yields are tabulated. The chemical purity of the labelled product was checked by radio gas chromatography from which it was deduced that a simple exchange reaction took place with the ethyl iodide, and that the free iodine content was not increased by the labelling procedure. This means that when using an organic iodide of high purity (i.e., free of elementary iodine) no purification of the labelled product is necessary. (UK)

24074 THORIUM AMMONIUM HEXAACETATE. Shmidt, V. S.; Andryushin, V. G.; Rybakov, K. A.; Pozharskaya, M. E.; Kozhevnikov, P. B. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 131-132(1973).

Translated from Radiochimiya; 15: No. 1, 130-132(1973).

Isolation of thorium ammonium acetate complex and the investigation of its properties are reported. The crystals are anisotropic; their density is 2.041 g/cm^3. The double salt is insoluble in ether, benzene, and ethyl alcohol. Chemical analysis of the substance formed as a result of heating to 180°C indicates that it is thorium acetate. (LK)

24075 COMPLEX FORMATION OF TRIVALENT PLUTONIUM WITH AMINO ACIDS IN AQUEOUS SOLUTIONS. Rogozina, E. M.; Konkina, L. F.; Popov, D. K. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 59-61(1973).

Translated from Radiokhimiya; 15: No. 1, 61-63(1973).

Complex formation of trivalent plutonium with glycine, alanine, serine, and aspartic and glutamic acids in aqueous solutions was investigated and the instability constants of the complex compounds formed were calculated by means of relative absorption curves. (auth)

24076 COMPLEX FORMATION OF TRIVALENT AMERICIUM, CURIUM, AND PROMETHIUM IONS WITH ETHYLENEDIAMINO-BIS-METHYLPHOSPHONIC ACID. Elesin, A. A.; Zaitsev, A. A.; Sergeev, G. M.; Nazarova, I. I. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 62-66(1973).

Translated from Radiokhimiya; 15: No. 1, 64-68(1973).

Complex formation of trivalent ions of americium, curium, and promethium with ethylenediamino-bis-methylphosphonic acid at an ionic strength of 0.5 and a temperature of 25°C was investigated by ion exchange on a cationite. The complexes $[M(H_2A)]^+$ are formed at $pH < 7$; this was confirmed by pH potentiometry data. (auth)

24077 KINETICS OF REDUCTION OF PLUTONIUM BY HYDRAZINE. I. Reduction of Pu(VI) to Pu(V). Koltunov, V. S.; Zhuravleva, G. I. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 73-76(1973).

Translated from Radiokhimiya; 15: No. 1, 74-77(1973).

Reduction of the PuO_2^{2+} ion to PuO_2^+ by hydrazine in nitric acid proceeds in accordance with a first-order equation relative to Pu(VI) and N_2H_4. The order of reaction with respect to H^+ ions with a constant ionic strength $\mu = 2$ equals -1. The rate constant of the reaction at 40°C equals 0.314 ± 0.042 min^{-1}. Nitrate ions have no appreciable effect on the reaction rate. The activation energy of the reaction found over the temperature range from 30 to 50°C equals 16.1 ± 0.2 kcal/mole. From the data obtained we calculated the enthalpy ($\Delta H^* = 15.5$ kcal/mole), free energy ($\Delta F^* = 21.6$ kcal/mole), and entropy ($\Delta S^* = -20.4$ entropy units) of activation. The reaction mechanism, which includes the slow stage of reaction of PuO_2OH^+ and $N_2H_5^+$ ions, is discussed. The entropy of formation of the activated complex $(PuO_2OHN_2H_5^{2+})^*$ in this stage $S^* = 0.3$ entropy units agrees with values of S^* for other activated complexes with a charge of 2^+. (auth)

24078 KINETICS OF OXIDATION OF U(IV)BY NITROUS ACID CATALYZED BY FERRIC IONS. Koltunov, V. S.; Marchenko, V. I. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 77-82 (1973).

Translated from Radiokhimiya; 15: No. 1, 78-84(1973).

An investigation was made of the kinetics of the oxidation of U(IV) by nitrous acid in the presence of Fe^{3+} ions in HNO_3 + $NaNO_2$ solutions with $\mu = 3$ over the temperature range of 15.5–39.8°C. The orders of reaction with respect to the reagents and H^+ ions were determined. The thermodynamic parameters of activation were calculated. A probable reaction mechanism is proposed and discussed. (auth)

24079 KINETICS OF REDUCTION OF NEPTUNIUM BY HYDRAZINE. I. Reduction of Np(VI) to Np(V) in Perchloric Acid. Koltinov, V. S.; Tikhonov, M. F. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 83-88(1973).

Translated from Radiokhimiya; 15: No. 1, 84-90(1973).

A study was made of the kinetics of reduction of hexavalent neptunium to the pentavalent state by hydrazine in perchloric acid solution with an ionic strength $\mu = 2$ in the temperature range of 25–45°C. It was shown that with excess hydrazine the reaction proceeds in accordance with the stoichiometric equation: $2NpO_2^{2+} + 2N_2H_4 = 2NpO_2^+ + 2NH_4^+ + N_2$, while with excess oxidant there is a parallel reaction: $4NpO_2^{2+} + N_2H_4 = 4NpO_2^+ + N_2 + 4H^+$. The rate of the reaction obeys the equation: $d[Np^{(V)}]/dt = k_0[Np^{(VI)}][N_2H_4]/[H^+]^{1.25}$, where $k_0 = 10.5 \pm 0.3\ M^{0.25} \cdot min^{-1}$ at 25°C. The reaction mechanism, which includes two slow stages, is discussed and the thermodynamic parameters of activation for the two reaction routes were calculated. (auth)

24080 KINETICS OF PYROHYDROLYSIS OF ANHYDROUS THORIUM TETRAFLUORIDE. Lazarev, L. N.; Andronov, B. V. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 89-95(1973).

Translated from Radiokhimiya; 15: No. 1, 90-97(1973).

In the initial stage (up to 70–80% removal of fluorine) the pyrohydrolysis of thorium tetrafluoride proceeds at a constant rate and then the rate of evolution of fluorine gradually falls. A study was made of the relation of the hydrolysis rate in both stages of the process to various factors, particularly, the temperature, the partial pressure of water vapor, the mass of the starting substance, the flow rate of the air–vapor mixture, and the surface area. While in the first stage the rate of fluorine evolution depends on the gas flow rate, the surface area, the temperature, and the partial pressure of water vapor, in the second stage internal diffusion begins to have an effect together with these factors. Kinetic equations are proposed for both stages of the reaction and the values of the parameters in them were determined. Using these equations it is possible tq calculate the time required for completion of the process under given conditions. (auth)

24081 POTENTIAL OF THE COUPLE Np(VI)–Np(V) IN SODIUM HYDROXIDE SOLUTIONS. Simakin, G. A.; Matyashchuk, I. V.; Vladimirova, N. A. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 96-103(1973).

Translated from Radiokhimiya; 15: No. 1, 98-100(1973).

By coulometry with a controllable potential the normal real potentials of the couple Np(VI)–Np(V) were found in 0.2 to 10 M sodium hydroxide solutions. The electrochemical oxidation of neptunium (V) and reduction of neptunium (VI) on a platinum electrode under these conditions obey Nernst's equation. (auth)

24082 ELECTRONIC STRUCTURE OF THE LANTHANIDES AND ACTINIDES AND ITS IMPORTANCE. Kanellakopulos, B. (Kernforschungszentrum, Karlsruhe, Ger.). Chem. Ztg.; 97: No. 10, 515-521(Oct 1973). (In German).

A brief review is presented on the electronic structure of the 4f and 5f elements. The lanthanide and actinide elements take a particular position in the periodic system as "inner transition elements" due to the specific properties of the f-electrons. These properties determine the behavior of the free ions and their chemical compounds. Several characteristic parameters and their relations to the electronic configuration are briefly discussed. Similarities and discrepancies between the lanthanide and actinide series are emphasized. (GE)

24083 COMPLEX FORMATION IN THE SYSTEMS URANIUM HALIDE–ALKALI METAL HALIDE. Preparation and Structure of Rb_2UBr_6 and Cs_2UBr_6. Vdovenko, V. M.; Kozhina, I. I.; Suglobova, I. G.; Chirkst, D. E. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 53-55(1973).

Translated from Radiochimiya; 15: No. 1, 54-57(1973).

The interaction of uranium tetrabromide with rubidium and cesium bromides leads to the formation of the compounds Rb_2UBr_6 and Cs_2UBr_6. The melting points and densities of these compounds were determined and x-ray diffraction patterns of polycrystals were obtained. Examination of the x-ray diffraction patterns of rubidium and cesium hexabromouranates (IV) shows that they have a cubic structure of the K_2PtCl_6 type. (auth)

24084 COMPLEX FORMATION IN THE SYSTEMS URANIUM HALIDE–ALKALI METAL HALIDE. Enthalpy of Formation of Rb_2UBr_6 and Cs_2UBr_6. Vdovenko, V. M.; Suglobova, I. G.; Chirkst, D. E. Sov. Radiochem. (Engl. Transl.); 15: 56-58(1973).

Translated from Radiokhimiya; 15: No. 1, 58-60(1973).

Standard enthalpies of formation of Rb_2UBr_6 and Cs_2UBr_6 at 25°C were determined. The determination was made by measuring the enthalpy of solution of the compounds studied in 0.5% $FeCl_3$ solution in 2% HCl. The enthalpy of formation of the hexabromouranate (IV) ion and the energy of the U–Br bond remain constant with a change from Rb_2UBr_6 to Cs_2UBr_6. The greater enthalpy of formation of Cs_2UBr_6 from the starting bromides in comparison with Rb_2UBr_6 cannot be explained from an examination of the bonds in the complex anion, but evidently results from the greater strength of the inner-sphere bonds in Cs_2UBr_6. (LK)

24085 KINETICS OF REACTION BETWEEN Pu^{4+} AND Mn^{3+} IONS. Koltunov, V. S.; Zhuravleva, G. I. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 67-72(1973).

Translated from Radiokhimiya; 15: No. 1, 68-74(1973).

The kinetics of oxidation of Pu^{4+} ions by trivalent manganese in perchloric acid solution with an ionic strength of 3.05 were investigated. The reaction rate is described by the equation

$$-(d[Mn^{(III)}]/dt) = [Mn^{(III)}]\ [Pu^{(IV)}]\ [(k_1 + k_2)/[H^+]]/[(K_1 + [H^+])\ (K_2 + [H^+])]$$

where $k_1 = 1.32 \cdot 10^3\ M \cdot min^{-1}$ and $k_2 = 6.38 \cdot 10^3\ min^{-1}$ at 25°C (K_1 and K_2 are the hydrolysis constants of Pu^{4+} and Mn^{3+} ions, respectively). The activation energy of the reaction equals 16.3 ± 1.0 kcal/mole. The reaction mechanism, which includes two slow stages of the reaction of $Mn(OH)_2^+$ ions with Pu^{4+} and $PuOH^{3+}$ ions, is discussed. (auth)

24086 pH DEPENDENCE OF COAGULATION AND CHARGE REVERSAL OF AQUO-ORGANO SILVER IODIDE SOL. Srivastava, V. K.; Rai, R. S. (Gorakhpur Univ., India). Proc. Nat. Acad. Sci., India, Sect. A; 41: No. 1-2, 143-148(1971).

When AgI sol in acetone and water is coagulated by Al^{3+} and Th^{4+} at different pH, some remarkable changes in the critical coagulation concentration take place. This critical coagulation is pH dependent between pH 4 and 7. The coagulation limit and coagulation region changes with pH. These changes are explained by the hydrolysis of these salts. In such case the adsorption of ions are governed by ionic charge as well as hydrolysis. Due to hydrolysis $Th(OH)^{3+}$ is formed, which is more strongly adsorbed and charge reversal takes place. With Al^{3+}, some hydrolyzed Al^{3+} species predominate. (Indian Sci. Abstr.)

24087 PREPARATION OF A ^{99m}/Tc-Sn-MAA KIT FOR USE IN NUCLEAR MEDICINE. Lyster, D. M.; Scott, J. R.; Mincey, E. K.; Morrison, R. T. (Univ. of British Columbia, Vancouver). J. Nucl. Med.; 15: No. 3, 198-199(Mar 1974).

A method of preparation of an MAA kit which has a high labeling efficiency with ^{99m}Tc, a consistent particle size, and stability with time is described. This kit can be prepared in varying amounts and should allow most nuclear medicine departments to take advantage of the desirable physical characteristics of ^{99m}Tc. (auth)

24088 RAPID METHOD FOR PREPARATION OF HUMAN FIBRINOGEN LABELED WITH ^{125}I. Peabody, R. A.; Halse, T.; Tsapogas, M. J. (Veterans Administration Hospital, Albany, NY). J. Nucl. Med.; 15: No. 3, 195-197(Mar 1974).

A method for the purification of human fibrinogen from fresh frozen plasma which can be completed in less than 5 hr is described. An initial cryoprecipitation step is followed by two selective precipitations of fibrinogen with polyethylene glycol 4,000. The average purity of 62 preparations was 93%. Yields of over 50% of the fibrinogen present in the starting plasma were routinely obtained. The fibrinogen obtained is suitable for labeling with ^{125}I. A procedure for labeling fibrinogen, modified from work of others, which makes the isolation and radioactive labeling of fibrinogen complete within one working day is described. (auth)

Radioactive Waste Treatment

Refer also to abstracts 24857–24860, 26188, and 26189.

24089 (ANL-8061) CHEMICAL ENGINEERING DIVISION WASTE MANAGEMENT PROGRAMS. Quarterly Report, July–September 1973. Steindler, M. J.; Levitz, N. M.; Trevorrow, L. E.; Gerding, T. J.; Kullen, B. J.; Webster, D. S.; Burris, L. (Argonne National Lab., Ill. (USA)). Jan 1974. Contract W-31-109-eng-38. 28p. Dep. NTIS $4.00.

This is the first quarterly progress report on three programs that have been undertaken at Argonne National Laboratory for the Division of Waste Management and Transportation of the USAEC. In a program to assess methods for consolidation of fuel-cladding hulls, work to date has been directed toward identifying and evaluating methods for the safe management and consolidation of waste Zircaloy hulls from the chop-leach reprocessing of spent fuel. As the first step in a program to identify methods for decontaminating metallic materials and equipment that have been used with plutonium, published decontamination procedures are being reviewed and evaluated. A third program is directed toward evaluation of proposed methods for the storage of tritium and noble-gas fission products. Initial studies have been directed toward a brief evaluation of the practicability of concentrating the tritium in fuel-reprocessing aqueous waste streams by converting the water to oxygen plus a tritium-hydrogen mixture and subsequently passing this mixture through palladium membranes. The results of a limited cost study showed that the power required to move the large volumes of hydrogen through the membranes is, in itself, prohibitively expensive. (auth)

24090 (BNWL-1806) STUDIES ON MANAGEMENT OF SELECTED WASTES. Quarterly Progress Report, October–December 1973. Schneider, K. J. (comp.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1974. Contract AT(45-1)-1830. 39p. Dep. NTIS $4.00.

A progress report for studies on management of nonhigh-level wastes being performed by Batelle-Northwest at the AEC's Pacific Northwest Laboratory is presented. Studies included in the report are: decontamination and densification of chop-leach cladding residues; waste treatment and handling processes; and tritium fixation. (auth)

24091 (BNWL-1809) RESEARCH AND DEVELOPMENT ACTIVITIES WASTE FIXATION PROGRAM. Quarterly Progress Report, October–December 1973. Platt, A. M. (Comp.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1974. Contract AT(45-1)-1830. 89p. Dep. NTIS $5.45.

Two 40-hr nonradioactive spray solidification runs were completed in which both PW-4b and PW-6 reference waste compositions were successfully converted into borosilicate glass. The throughput capacity of the 13-in. diameter spray calciner while processing PW-4b waste is over 38 l/hr with a 700°C calciner wall and 24-30 l/hr with a 550°C wall. Mechanical agitation increases the capacity of the inconel melter to over 4.5 l of melt per hour and greatly improves product homogeneity. Both PW-4b and PW-6 reference waste compositions were successfully concentrated in the nonradiactive, wiped film evaporator (WFE) facility. Either waste can be concentrated to approximately 60 wt% total solids in the WFE. For the PW-6 waste, this represents removal of about 80% of the initial liquid present in the waste. Two ceramic melters were built and operated, each using molybdenum electrodes for heating. While the performance of these first melters indicated a number of design and construction problems which need to be resolved, a ceramic-electrode heated melter appears to be a viable alternative to metallic melters. The PW-4b melt composition 72-68 contains finely divided crystallites when large quantities are melted at 1150°C. The crystallites were identified as CeO_2, a spinel and zircon, with CeO_2 the predominant species. Several options for eliminating the crystallites include increasing the melt temperature, agitating the melt to prevent crystal settling, modification of the composition to promote CeO_2 solubility, and reducing the concentration of CeO_2 in the glass. Helium gas formed by alpha particle emission from actinide nuclides in high-level waste glasses can produce large internal stresses in the glass. A porosity of 0.2% in typical waste glasses, from uranium oxide fuel, may be sufficient to reduce the internal stresses to inconsequential levels by providing sites for gas accumulation. However, for waste glasses from plutonium recycle fuel, a higher than anticipated porosity of approximately 3% may be required. Mass spectrographic analysis was performed on the gas phase from several canisters of solidified radioactive waste from the previous Waste Solidification Engineering Prototypes (WSEP) program. Analysis of the gas in several phosphate glass canisters revealed CO_2, present from the decomposition of residual Purex solvent and silicone antifoam agent, and N_2O from the decomposition of nitrate. Hydrogen was below detection limits. Oxygen depletion of the original air atmosphere was the only change found in limited sampling of spray solidified and pot calcine product canisters. (auth)

24092 (DP-1343) MERCURY REMOVAL FROM AQUEOUS PROCESS STREAMS. Tharin, D. W. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Jan 1974. Contract AT(07-2)-1. 24p. Dep. NTIS $4.00.

A simple method for removing mercury from aqueous process streams has been developed. The system consists of a column packed with finely ground vulcanized rubber preceded by a liquid cyclone separator. In one test, a pilot-scale packed bed containing finely ground tire rubber produced an effluent having <10 ppb mercury for 170 bed volumes throughput, and <100 ppb for over 600 bed volumes. Feed solution contained 1800 to 11,000 ppb mercury in a dissolved or colloidal state. In batch laboratory tests, mercury was reduced from 750 ppb to less than 5 ppb in five minutes at 70°C. The ability of rubber to capture mercury in almost any physical or chemical form over a wide range of pH and concentration provides an economical method for cleaning up waste effluent from many industrial sources. This process uses one waste product to control another and at a cost below that of previously described processes. The use of discarded tire rubber to absorb mercury may have wide application. (auth)

24093 (RFP-Trans-147) APPLICATION OF COUNTER-FLOW ION MIGRATION FOR SEPARATION OF ACTINIDES. Abdel-Latif Bilal, B.; Metscher, K.; Muhlig, B.; Reichmuth, C.; Schwarz, B. Translated from Chem.-Ing.-Tech.; 45: No. 12, 841-846(1973). 12p. Dep. NTIS $3.00.

The method of counterflow ion migration in aqueous solutions is proposed for separation of the actinides from the hot waste from the reconditioning of spent nuclear fuels as well as for the working of irradiated transuranium targets such as ^{237}Np, $^{241-243}$Am, ^{239}Pu and ^{242}Pu used in obtaining the nuclides that serve as energy or neutron sources. A separation procedure that seems to be universal and suitable for this task and that is based on the difference in ion mobilities was developed on the laboratory scale and was first tested in cold operation on the laboratory scale. (auth)

24094 PURIFICATION AND CONCENTRATION OF LIQUID LOW-LEVEL RADIOACTIVE WASTES BY REVERSE OSMOSIS. Dytnerskii, Yu. I.; Pushkov, A. A.; Svittsov, A. A.; Trofimov, D. I.; Zhilin, Yu. N.; Grigor'ev, V. G. At. Energ. (USSR); 35: No. 6, 405-408(Dec 1973). (In Russian).

The essence of the reverse osmosis method is described. Experimental results on purification and concentration of liquid low-level wastes at the Moscow purification station are presented. Decontamination factors for individual radioisotopes are given. The possibility of using semi-permeable cellulose acetate membranes for the purification of liquid radioactive wastes is discussed. (auth)

24095 HANDLING OF AIRBORNE RADIOACTIVE WASTES. Cejnar, R.; Kepak, F.; Razga, J. pp 22-30 of Review of Research and Development Activities in the Nuclear Research Institute. Rez, Czech.; Ustav Jaderneho Vzykumu (1973).

Literature data are briefly reviewed on the removal of gaseous iodine and its compounds and of noble gases from airborne radioactive wastes. A special porous styrene-divinylbenzene copolymer is described whose structure was modified by functional amino groups. The capture and fixation of hydrogen iodide, methyl iodide, and vapors of radioactive iodine is based on an irreversible chemical reaction of tertiary amino groups introduced into the porous copolymer. The porous structure of the copolymer ensures rapid sorption-fixation reactions. The separation of aerosols as well as the problems of volatile radionuclide escape from solidified products are also briefly reviewed. (INIS)

24096 ACID DIGESTION: A NEW METHOD FOR TREATMENT OF NUCLEAR WASTE. Lerch, R. E.; Cooley, C. R.; Atwood, J. M. (Hanford Engineering Development Lab., Richland, WA). Westinghouse Eng.; 33: No. 5, 146-149(Sep 1973).

Acid digestion is a new process being developed to treat contaminated combustible waste materials. The process decomposes waste materials in hot (230 to 270°C) concentrated sulfuric acid in the presence of nitric acid oxidant. The waste materials are converted into noncombustible residues of considerably less volume. The process readily converts such waste materials as ion-exchange resin, polyvinyl chloride, polyethylene, wood, paper, rags, styrofoam, latex rubber, and neoprene rubber into a low-volume noncombustible chemical residue. Average volume and weight reductions on mixed waste are about 60 and 6, respectively. Volume reduction achieved on eighteen specific materials is listed. Control of the process, residue characteristics, plutonium recovery, and safety are discussed. Scale-up studies, conceptual flowsheet development, and future studies are described. (MCW)

24097 SOLIDIFICATION OF HIGHLY RADIOACTIVE WASTES IN PHOSPHATE GLASS. Lahr, H. Technical Meeting No. 9/19. Basel; Nuclex (1972). 12p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

A procedure is described which consists of the following stages: denitration-evaporation, vitrification, recovery of nitric acid and treatment of exhaust gases. The procedure can be preceded by preconcentration. The procedure which has proven to work satisfactorily in the experimental facility produces, in addition to the glass block, one single exhaust gas, concentrated nitric acid and a low-activity condensate. (auth)

Radioisotope Production

24098 (BNL-18447) RECENT DEVELOPMENTS AND NEW APPROACHES AT THE CYCLOTRON FOR THE PREPARATION OF SHORT-LIVED NUCLIDES FOR RADIOPHARMACEUTICALS. Lambrecht, R. M.; Wolf, A. P. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 38p. (CONF-740203-4). Dep. NTIS $4.00.

From international symposium on radiopharmaceuticals; Atlanta, Georgia, USA (12 Feb 1974).

The desirability and choice of short-lived halogens, nuclide decay characteristics, cyclotron production methods and yields, preparation of halogenating reagents and applications of the short-lived nuclides to radiopharmaceuticals are reviewed. Systems design for automation at the cyclotron for the production of anhydrous, carrier-free nuclides, ^{18}F, ^{34m}Cl, ^{77}Kr(^{77}Br), ^{79}Kr, $^{123(5)}$Xe($^{123(5)}$I) and the respective labeling reagents, particularly with the short-lived generator systems: $^{18}\mathrm{Ne} \xrightarrow{1.5\ \mathrm{sec}} {}^{18}\mathrm{F}$, $^{77}\mathrm{Kr} \xrightarrow{1.2\ \mathrm{hr}} {}^{77}\mathrm{Br}$, and $^{123}\mathrm{Xe} \xrightarrow{2.1\ \mathrm{hr}} {}^{123}\mathrm{I}$ and $^{125}\mathrm{Xe} \xrightarrow{16.8\ \mathrm{hr.}} {}^{125}\mathrm{I}$ is stressed. The principles of carrier-free excitation labeling with the rare gas halogen generators are summarized. The scanning electron microscope was used for evaluation of the target performance for ^{125}Xe. The rapid "on-line" methods being developed for the halogens and the rare gases are applicable to other nuclides, and will facilitate the practical application of short-lived nuclides in new radiopharmaceuticals. The limitations of a compact medical cyclotron for the production of many nuclides appropriate for radiopharmaceuticals are noted. (auth)

24099 (IFA-RC-7-1973) CYCLOTRON PRODUCTION OF ^{85}Sr. Popa, L. I.; Arsenie, I. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 8p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

The production of carrier-free ^{85}Sr in the U-120 cyclotron from targets of rubidium carbonate irradiated with protons is reported. The radioisotope is separated from its parent on ion exchange resins. The method is marked by its simplicity and rapidity. (tr-auth)

24100 THERMAL DIFFUSION ISOLATION OF TRITIUM FROM ALUMINUM AND COPPER. Mekhedov, B. N.; Ishutin, V. V.; Sukhotin, L. N. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 136-138(1973).

Translated from Radiokhimiya; 15: No. 1, 134-136(1973).

An investigation was made of the isolation of tritium formed in reactions with high-energy protons from aluminum and copper by isothermal and isochronous heating in hydrogen. For Al the isolation of $^{3}_{1}$H is described by the diffusion equation: $D = D_0 \exp(-E/RT)$, where $D_0 = 5 \cdot 10^{-4}$ cm^2/sec and E = 7.5 kcal/mole for $t > 250°C$ and $D_0 = 2.0 \cdot 10^{2}$ cm^2/sec and E = 20 kcal/mole for $t < 250°C$. It was not possible to obtain a similar relation with copper. The experimental investigation of the temperature dependence of the diffusion coefficient and extrapolation of it to room temperature gave D for Al and Cu $1.5 \cdot 10^{-13}$ cm^2/sec and $<10^{-17}$ cm^2/sec, respectively, but with copper there was the formation of tritiated water, which could produce a "memory" effect. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 23935, 24122, 24648, and 26176.

24101 BY-PRODUCT RECOVERY IN THE REPROCESSING OF NUCLEAR FUELS. Gourisse, D. (CEN, Fontenay-aux-Roses, France). Bull. Inform. Sci. Tech. (Paris); No. 185, 5-29 (Oct 1973). (In French).

Some transuranic elements (^{237}Np, ^{241}Am, ^{243}Am, ^{242}Cm, and ^{244}Cm) and fission products (^{137}Cs, ^{90}Sr, ^{144}Ce and ^{147}Pm) appear as useful by-products in the reprocessing of nuclear fuels. Recovery processes are reviewed. Particular emphasis is given to large-scale processes, especially to solvent extraction based methods. Processes developed in France are outlined and situated in the international context. (FR)

ENGINEERING

Energy Conversion

Refer also to abstracts 24350, 24767, 25804, and 25806.

24102 (AD-764277) PORTABLE THERMOELECTRIC GENERATOR. Quarterly Report No. 1, 1 May–31 July 1962. Miller, N. C.; Lockwood, R. A. (Atomics International Div., Canoga Park, Calif. (USA)). 29 Aug 1962. Contract DA-44-009-eng-5000. 26p. (AI-7642). NTIS $3.00.

Progress is reported on a 150-W portable thermoelectric generator, employing a leaded gasoline burner as the heat source, and weighing no more than 30 lb, including fuel for 4-h operation. A process was developed for forming rectangular hexahedral semiconductor thermoelectric elements from granular starting material, by hot pressing in graphite dies. The thermoelectric materials selected are commercially available PbTe with 0.055% PbI_2(n elements) and PbSnTe (p elements). The gasoline burner and an aspiration system for the intake of both combustion and cooling air have been intensively analyzed. Critical nozzle experiments are under construction. The design of the energy conversion stage is substantially complete. (auth)

24103 (AD-766232-3) DEVELOPMENT OF DESIGN CRITERIA, COST ESTIMATES, AND SCHEDULES FOR AN MHD HIGH PERFORMANCE DEMONSTRATION EXPERIMENT. Final Report, April 1972–April 1973. Garrison, G. W.; Brogan, T. R.; Schmidt, H. J.; Nolan, J. J. (Arnold Engineering Development Center, Arnold Air Force Station, Tenn. (USA)). Aug 1973. 117p. (AEDC-TR-73-115). NTIS $4.25.

The successful application of magnetohydrodynamics (MHD) for commercial, coal-fired, base-load power generation requires that the generator have an energy extraction ratio of approximately 0.20 with a turbine efficiency of 70%. There is a significant gap between this required performance and the generator performance which has been achieved to date. The commercial MHD concept is critically dependent upon the generator achieving this required performance, and it is therefore essential that a demonstration of this generator performance have the highest priority. Of equal importance, the generator channel configuration and operating conditions which are necessary in order to achieve the required performance will be determined while accomplishing the performance demonstration. Thus other Office of Coal Research (OCR) sponsored MHD research efforts can be directed toward the real problems and configurations as determined by solid experiments. (auth)

24104 (AD-766493-1) INVESTIGATION OF A NONEQUILIBRIUM MHD GENERATOR. Annual Report, 1 August 1972–31 July 1973. Zauderer, B. (General Electric Co., Philadelphia, Pa. (USA)). Aug 1973. Contract N00014-73-C-0039. 33p. NTIS $3.00.

The report presents research results on the following: the ST-40 MHD channel; the 4 Tesla magnet for the ST-40 MHD channel; MHD generator theoretical analyses; Gas dynamic performance, ST-40 channel; MHD generator performance, ST-40 channel; and gas dynamic performance. (auth)

24105 (AD-766500-3) CLOSED CYCLE MHD FOR CENTRAL STATION POWER WITH FOSSIL OR NUCLEAR FUELS. Zauderer, B.; Marston, C. H.; Cook, C. S. (General Electric Co., Philadelphia, Pa. (USA)). Aug 1973. Contract N00014-73-C-0039. 47p. (ONR-TR-20). NTIS $3.00.

A closed-cycle MHD generator using a noble gas with alkali metal vapor as the working fluid, when used as a topping unit for a conventional steam plant, can yield cycle efficiencies in excess of 60% at peak stagnation temperature of 3000°F. While high enough for substantial gains in thermodynamic efficiency, this temperature is relatively low for an electrically conducting gas and conductivity is achieved by decoupling electron temperature from gas temperature. A ceramic regenerative heat exchanger supplies thermal energy to the working fluid. The latter can be any clean fossil fuel, preferably low BTU (about 150 BTU/SCF) coal gas. With multi-stage combustion, pulverized coal is also a possible fuel. On a long range basis, closed cycle MHD is ideally suited for high temperature gas cooled fission reactors and probably also to fusion reactors. The closed cycle MHD generator is adaptable to the Brayton cycle, the regenerative Brayton cycle and eventually the Rankine cycle. (auth)

24106 (AD-766588-8) EXPERIMENTAL TWO-PHASE LIQUID-METAL MAGNETOHYDRODYNAMIC GENERATOR PROGRAM. Annual Report, 1 May 1972–1 May 1973. Amend, W. E.; Cole, R.; Cutting, J. C.; Pittenger, L. C. (Argonne National Lab., Ill. (USA)). Jun 1973. Contract NAonr-19-72. 78p. (ANL/ENG-73-2). NTIS $3.75.

Extensive data on the contoured generator has been taken which corroborates the very preliminary data reported previously. Detailed experimental parametric studies were completed which mapped generator performance as a function of mixture quality, magnetic field, and generator loading. Turbine efficiencies of 50% have been achieved for the first-generation contoured generator. The experimental data, coupled with theoretical analyses and modeling, however, has shown conclusively that an electrical shunt exists within the generator. Extensive data has also been taken on the generator with constant cross-sectional inserts; similar results were obtained. Several possible causes for the electrical shunt were identified. In order to identify and isolate the principal electrical shunt, the following steps were taken: the generator was redesigned and rebuilt to completely eliminate leakage and thus the shunt behind the insulator wall; a gas-cleaning system and a micropore NaK filter was installed to minimize the amount of gas impurities that could enter the test facility and remove any oxides as soon as they are formed. These steps were successfully carried out and a new series of performance runs are planned. As the testing proceeds, the effects of the mechanical and fluid boundary-layer-type shunts can be separated. Control of the boundary-layer shunt will be accomplished with a gas injection system. (auth)

24107 (AD-767584-6-GA) LINCOLN EXPERIMENTAL SATELLITES 8 AND 9 HOT DROP TESTS. Technical Report, 21 April–7 July 1972. Tate, D. L.; Zigler, G. L. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Oct 1973. 40p. (AFWL-TR-73-171). NTIS $3.00.

An adequate nuclear safety evaluation is conducted for any USAF launched mission which uses nuclear powered electrical generators. The Lincoln Experimental Satellites 8 and 9 (LES 8/9) are such a mission. The total inventory of plutonium-238 is in excess of 280,000 curies. Terminal velocity and impact orientation of the radioisotope thermoelectric generators (RTG) are required. Actual drop tests of simulated models were deemed the most appropriate and expeditious method for obtaining the necessary basic data. Two electric furnaces mounted on the cargo ramp of a C-130A aircraft were used in the conduct of the tests. Simulated components of the RTGs were dropped on White Sands Missile Range (WSMR), some at ambient temperature and the remainder at about 1500°F. Optical and radar tracking along with motion picture coverage provided the necessary information on velocity and orientation. The hot body effect was observed, i.e., identical objects fell some 18 percent slower when dropped after being heated to about 1500°F as opposed to those dropped at ambient temperature. The tests were completed ahead of schedule and exceeded all objectives. (auth)

24108 (JPRS-61359) THERMAL CYCLE AND EFFICIENCY OF A VERSATILE POWER UNIT WITH A MAGNETOHYDRODYNAMIC GENERATOR AND THERMOELECTRIC GENERATOR. Kirillin, V. A. Translated from Teplofiz. Vys. Temp.; 11: No. 5, 1088-1091(1973). 8p. NTIS.

A MHD generator circuit is described with an overload mode capacity making operation possible in a wide range of loads. (auth)

24109 (NP-19958) GLOSSARY OF TERMS AND SYMBOLS IN THERMIONIC CONVERSION. (Organization for Economic Co-Operation and Development, 75, Paris (France)). 1971. 117p. Dep. NTIS (U.S. Sales Only) $8.00. ENEA $15.00.

The terms and their definitions are grouped into sections dealing with different aspects of thermionic conversion. An overall index of the terms is presented with French and Russian translations. (TFD)

24110 TIMEPIECE HAVING A NUCLEAR POWER SOURCE. Adler, K.; Ducommun, G. (to Biviator, S. A.). US Patent 3,791,134. 12 Feb 1974. Priority date 23 Feb 1970, Sweden. 2p.

A timepiece comprising a nuclear power source in a capsule having a sensitive insulation of an output terminal is described. This insulation and output terminal respectively is protected by a protecting plate forming an intermediate back. (Official Gazette)

24111 THERMO-ELECTRIC MODULAR STRUCTURE AND METHOD OF MAKING SAME. Freedman, N. S.; Horsting, C. W.; Lawrence, W. F.; Carrona, J. J. (to United States Atomic Energy Commission). US Patent 3,787,958. 29 Jan 1974. Filed date 18 Aug 1965. 6p.

A method is presented for making a thermoelectric module with the aid of an insulating wafer having opposite metallized surfaces, a pair of similar equalizing sheets of metal, a hot-junction strap of metal, a thermoelectric element having hot- and cold-junction surfaces, and a radiator sheet of metal. The method comprises the following steps: brazing said equalizer sheets to said opposite metallized surfaces, respectively, of said insulating wafer with pure copper in a non-oxidizing ambient; brazing one surface of said hot-junction strap to one of the surfaces of said equalizing sheet with a nickel-gold alloy in a non-oxidizing ambient; and diffusion bonding said hot-junction surface of said thermoelectric element to the other surface of said hot-junction strap and said radiator sheet to said cold-junction surface of said thermoelectric element, said diffusion bonding being carried out in a non-oxidizing ambient, under compressive loading, at a temperature of about 550°C., and for about one-half hour. (Official Gazette)

24112 METHOD FOR ESTIMATING OPTIMUM LOAD RESISTANCE OF A SILICON SOLAR CELL USED IN TERRESTRIAL POWER APPLICATIONS. Rao, A. B. (Electronics Corp. of India Ltd., Hyderabad); Padmanabhan, G. R. Solar Energy; 15: No. 2, 171-177(Jul 1973).

Solar intensity undergoes significant changes from dawn to dusk. Further, the power output of a silicon solar cell is a function of the load resistance. A load resistance (R_m) giving maximum conversion efficiency at mid-day becomes less efficient at other times of the day under reduced intensity levels. The load resistance must be optimized to derive maximum overall power output for the whole day, taking intensity variations into account. A method for estimating the optimum load resistance (R_{opt}) is presented here. It is also shown that considerable improvement in the output of a terrestrial power system could be achieved at solar intensities ≤ 100 MW cm^2. (auth)

24113 PRELIMINARY TESTS OF A 1 MWt MAGNETOHYDRODYNAMIC GENERATOR. Dogaru, I.; Grecov, D.; Katona, L.; Cserveny, I. Rev. Roum. Sci. Tech., Ser. Electrotech. Energ.; 18: No. 4, 729-742(1973).

A 1 MW(t), magnetohydrodynamic generator designed and constructed at ICPET, Bucharest is described. The MHD-02 generator operates in open circuit with plasma obtained by the combustion of natural gases in preheated air enriched with oxygen. It includes a combustion chamber, an acceleration nozzle, a conversion channel, a diffuser, a scrubber, an air preheater, an electromagnet, a seeding device, an oxygen installation, a water cooling installation, an inverter and a measurement installation. The operation regimes of the subassemblies are described within the preliminary tests of the generator. Also given are the results of measurements in the conversion channel. (auth)

24114 NONLINEAR INTERNAL RESISTANCE OF AN EGD GENERATOR. Malaczynski, G. W. Pr. Inst. Masz. Przeply.; 58: 3-9(1972).

An electrogasdynamic generator model is presented in which account is taken of the influence of the outlet section of the process in the region of conversion. By formulating appropriate boundary conditions for the selected generator model, it was possible to determine nonlinear internal resistance of the generator as a function of flow parameters and the model geometry. (Appl. Mech. Rev.)

Facilities and Equipment

Refer also to abstracts 24220, 24526, 24744, and 26270.

24115 (AAEC/E-274) DESIGN AND PERFORMANCE OF PUMP-MIX AND GRAVITY-FLOW MIXER-SETTLERS. Royston, D.; Burwell, A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1973. 57p. Dep. NTIS (U. S. Sales Only) $5.00.

The historical development of pump-mix and gravity-flow mixer-settlers is reviewed and their operating and design features, including scale-up, are discussed. An experimental study of the hydraulic operating characteristics of two such units, an AAEC-designed pump-mix mixer-settler based on the original KAPL work and a UKAEA Windscale gravity-flow mixer-settler is described. The pump-mix unit was shown to be less flexible in operation than the gravity-flow unit and it is shown that an increase in size of all the ports will increase the throughput of the pump-mix mixer-settler. (auth)

24116 (BNWL-CC-1733) FINAL SAFETY ANALYSIS REPORT FOR THE GAMMA IRRADIATION FACILITY. Baker, D. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 15 Jul 1968. Contract AT(45-1)-1830. 11p. Dep. NTIS $3.00.

The gamma irradiation facility is located in the approximate center of the 3730 Building, 300 Area. The pool-type facility presently contains 295,000 Ci of ^{60}Co under 13½ ft. of water. Irradiations are generally conducted in stainless steel tubes which extend from above the surface of the water to the bottom of the tank. This safety analysis report contains data from a previous engineering review. (auth)

24117 (BNWL-CC-1733(Supp. 1)) FINAL SAFETY ANALYSIS REPORT FOR THE GAMMA IRRADIATION FACILITY, SUPPLEMENT 1. Baker, D. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 27 May 1969. Contract AT(45-1)-1830. 7p. Dep. NTIS $3.00.

The safety analysis report for the Gamma Irradiation Facility contained a description of the facility and a safety analysis based on an inventory of 295,000 Ci of ^{60}Co. Plans are being made to increase the ^{60}Co inventory to 600,000 Ci. This supplement reviews the safety aspects of the facility for the case in which the source contains 600,000 Ci of ^{60}Co. (auth)

24118 (COO-1605-1) DESIGN OF EFFICIENT, LARGE-SCALE CHROMATOGRAPHIC COLUMNS. Final Report. Sparks, R. E.; Edwards, R. V.; Dybbs, A. (Case Western Reserve Univ., Cleveland, Ohio (USA)). [nd]. Contract AT(11-1)-1605. 60p. Dep. NTIS $5.00.

The major contributions during the contract period were: development of a thermistor anemometer permitting velocity measurement in the chromatographic range; design of highly efficient inlet devices for use with large columns; modelling of dispersion mechanisms in packed columns; correlation of dispersion with packing geometry and arrangements; and development of a Laser Doppler Anemometer for interstitial velocity measurements inside a packed column. (auth)

24119 (LA-5502-MS) HEAT TRANSFER AND THERMAL TREATMENT PROCESSES IN SUBTERRENE-PRODUCED GLASS HOLE LININGS. Stanton, A. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 13p. Dep. NTIS $4.00.

Glass-forming and thermal treatment processes for the glass liners of bore holes produced by Subterrene rock-melting penetrators are considered. Analytical and numerical calculations of the radial temperature distributions and glass cooling rates are reported for the glass-like liners created by laboratory penetrators operating in local Los Alamos tuff and basalt. The temperature calculations are compared with experimental data. The cooling rate at the inside surface of the glass liner is strongly influenced by the penetrator afterbody and stem design. To minimize residual stresses in the cooled glass, a qualitative correlation is found between this cooling rate and the thermal properties of the parent rock. The magnitude of residual strains and stresses in glass produced by laboratory penetrators is estimated. (auth)

24120 (RDT-P-4-3-T(2-74)) METAL-SHEATHED, MINERAL-INSULATED ELECTRICAL RESISTANCE HEATER. (USAEC Division of Reactor Research and Development, Washington, D.C.). Feb 1974. 17p. RSO.

The requirements for tubular, metal-sheathed, double ended electrical resistance heaters having compacted mineral-oxide insulation are presented. The standard treats only single-wire, helical heater elements. The standard is applicable to liquid metal heat transfer systems for preheating (low temperature) and for component operating temperatures up to 677°C (1250°F), where the heaters are mounted either directly on the component surface to be heated or on standoffs in the gas space between the component surface and the thermal insulation. (TFD)

24121 (RISO-M-1673) ROLE OF THE MAN-MACHINE INTERFACE IN SYSTEMS RELIABILITY. Rasmussen, J. (Danish Atomic Energy Commission, Risoe. Research Establishment). Nov 1973. 11p. (CONF-730714-4; R-10-73). Dep. NTIS (U. S. Sales Only) $3.00.

From Generic techniques in systems reliability assessment conference; Liverpool, UK (16 Jul 1973).

The use of probabilistic reliability evaluation of industrial process plants is discussed. In this application low probability events leading to severe consequences have to be identified and included in the analysis. Human malfunctions in abnormal tasks are an important factor in such events, but human behavior in higher level mental tasks cannot yet be predicted. It is therefore important to verify the limits of use of existing methods of reliability prediction. (auth)

24122 (RL-SEP-49) EVALUATION OF OVER-ALL HEAT TRANSFER COEFFICIENTS: PUREX E-F6 AND E-H4 CONCENTRATIONS. Preliminary Report. Smith, C. W.; Galbraith, K. P. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 2 Nov 1964. 13p. Dep. NTIS $3.00.

The determination of the required size of the tube bundles for the Purex concentrators has been subject to many uncertainties, primarily due to a lack of representative heat transfer coefficients obtained under actual plant operating conditions. It is necessary that the tube bundles have adequate capacity to allow operation of the plant at a high throughput rate without requiring undesirable flowsheet changes, yet at the same time the cost of the tube bundles prohibits making them excessively large in order to have a comfortable margin. In an attempt to provide more definitive heat transfer design coefficients, data have been taken on the E-F6 and E-H4 Concentrators since early February and analyzed for the heat transfer coefficient. The heat transfer coefficients that have been calculated from the data are presented. The accuracy of the data and the need for additional studies are discussed. (auth)

24123 KINEMATIC DESIGN OF GUIDES AND FINE ADJUSTMENT DEVICES. Pollerman, M. Kerntechnik; 15: No. 12, 541-547(Dec 1973). (In German and English).

In nuclear and physical engineering, guidance and adjustment problems often occur with extremely stringent requirements which cannot be satisfied by conventional devices used in machine construction. In such cases, it is advisable to base the design of such devices on the principles of kinematics. A scheme, universally applicable for such purposes and some examples of its uses are presented. (GE)

24124 13TH INTERNATIONAL CONGRESS OF THEORETICAL AND APPLIED MECHANICS, MOSCOW, USSR, AUGUST 21-26, 1972. Mikhailov, G. K. (ed.). Moscow; International Congress of Theoretical and Applied Mechanics (1972). 116p. (In Several Languages). (CONF-720848-(Absts.)). $5.00.

Abstracts of the papers given at the Congress are presented. No other publication covering the proceedings will be issued. (TFD)

Heat Transfer and Fluid Flow

Refer also to abstracts 24132, 25951, 25996, and 26193.

24125 (CEA-CONF-2399) MEASUREMENT OF TWO PHASE CRITICAL FLOW OF STEAM-WATER AT LOW QUALITY AND SUBATMOSPHERIC PRESSURE. Lafay, J.; Picut, M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Transfert et Conversion d'Energie). [nd]. 57p. (In French). (CONF-720686-5). Dep. NTIS (U. S. Sales Only) $5.00.

From European two-phase flow group meeting; Rome, Italy (6 Jun 1972).

Critical flow rate of two-phase steam-water mixtures in the low quality region was measured at the exit of an annular test section in a forced convection boiling loop (BEATRICE) over a very low exit pressure range at the condenser, from 0.2 to 1 bar absolute. This investigation was carried out on a channel for which the geometric characteristics are similar to those of the sodium forced convection facility (CFNa). The axially centered rod had a 7 mm O. D. with a heated length of 600 mm followed by an adiabatic length of about 400 mm and the outer tube which is transparent had a 9 mm ID. An experimental method of measuring the critical flow rate during study state boiling is described. Results are correlated by plotting the critical mass velocity as a function of quality which is calculated with the thermodynamic equilibrium assumption. Exit pressure was found to have a very large influence on the critical flow for a constant quality. The comparisons with water and sodium experiments are presented. A proposal to make calculations with a code to determine similarity law between these two fluids at critical flow is made. (auth)

24126 (EUR-5069) INVESTIGATION OF THE HYDRODYNAMIC BEHAVIOUR OF ARGON BUBBLES IN NaK IN NARROW CHANNELS. Navarre, J. P. H.; Moureau, J. C. L.; Giot, M. (Commission of the European Communities, Luxembourg; Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). Jan 1974. 43p. (In French). Dep. NTIS (U.S. Sales Only) $4.25.

The subject of this research was to determine the rising velocity of gas slugs in narrow channels and their blockage conditions. Argon bubbles and slugs have been injected in different internal diameter tubes (5.8 to 10.03 mm) in stagnant as in forced convection conditions. The tests were carried out in order to check the flow analogy and to verify the theoretical model elaborated with non-metallic liquids during a preliminary study. The hydrodynamic behavior of bubbles is shown to be similar in both kinds of liquid. The only observed differences are due to the peculiar thermal properties of liquid metals. The theoretical model is in good agreement with the experimental results. (auth)

24127 (ORNL-TM-4497) HEAT TRANSFER AND FLUID FLOW BIBLIOGRAPHY. Nestor, C. W. Jr. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 48p. Dep. NTIS $4.50.

This bibliography consists of about 300 references assembled during the design and implementation of two computer programs for the calculation of steady-state and transient temperature distributions. The majority of items, therefore, deal with computer programs and computational methods for the solution of heat conduction problems. However, some entries deal with radiative and convective heat transfer, fluid flow, thermal properties, and with mesh generation. The material contained in this tabulation is maintained in computer-accessible form so that the bibliography can be used with any of the programs in the ORCHIS information system. No claims are made for completeness; comments, corrections and contributions of more references are earnestly solicited. An author index is provided. (auth)

24128 (SLL-73-5281) FEMESH: A FINITE ELEMENT CODE PREPROCESSOR. Gabrielson, V. K. (Sandia Labs., Livermore, Calif. (USA)). [nd]. 23p. (CONF-730626-2). Dep. NTIS $3.25.

From ASME meeting; Miami Beach, Florida, USA (24 Jun 1973).

A mesh generator which is used as a preprocessor to finite element and finite difference codes used in heat transfer and structural analysis is described. Emphasis is on the attributes of this processor to finite element codes which use the i-j unit grid as a coding procedure for internal data storage. In addition, the use of this generator with interactive graphics and input/output terminals is described. (auth)

24129 STRUCTURE AND HYDRAULIC FRICTION OF TURBULENT SWIRLING FLOW IN SHORT TUBES. Sobin, V. M.; Ershov, A. I. (Belorussian Technological Inst., Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 3, 56-61(1972). (In Russian).

The results of the experimental investigation of the velocity fields and hydraulic friction of swirling flow in tubes with a length of $1/d = 4$ are reported. Formulas are obtained for the basic and tangential components of the velocity according to the radius and length of the tubes. Two forms of swirling flow are established. The dependences for the friction coefficient of the input and output for all tubes are given. The friction coefficients in swirling and basic flow are presented. (tr-auth)

Materials Testing

Refer also to abstracts 24579, 24706, and 24901-24903.

24130 IMAGING TECHNIQUES FOR TESTING AND INSPECTION. Proceedings of the Society of Photo-Optical Instrumentation Engineers, Los Angeles, California, February 14-15, 1972. Urbach, J. C.; Brenden, B.; Aprahamian, R. (Eds.). Proceedings of the Society of Photo-Optical Instrumentation Engineers, Volume 29. Redondo Beach, CA; Society of Photo-Optical Instrumentation Engineers (1972). 154p. (CONF-720232-).

Eighteen papers were presented at the conference. A separate abstract was prepared for each of 5. One paper appeared previously in NSA as Abstract No. 28: 14473. The remaining 12 papers on photo-optical imaging techniques were not within the scope of NSA. (LCL)

For abstracts of individual papers see: 24131-24135.

24131 OVERVIEW: ADVANTAGES OF IMAGING TECHNIQUES FOR NONDESTRUCTIVE TESTING. Berger, H.; Reimann, K. J. (Argonne National Lab., IL). pp 3-7 of Imaging Techniques for Testing and Inspection. Urbach, J. C. (Ed.). Redondo Beach, CA; Society of Photo-Optical Instrumentation Engineers (1972).

From meeting on imaging techniques for testing and inspection; Los Angeles, California, USA (14 Feb 1972). See CONF-720232-.

Imaging techniques for nondestructive testing methods such as x-ray and gamma radiography, neutron radiography, ultrasonic inspection, and light inspection are reviewed and compared on the basis of ease of communication and interpretation, applicability to dynamic testing, i.e., inspection during a process, efficiency, spatial resolution, inspection speed, possibility of human errors, and permanence of test data. (LCL)

24132 DYNAMIC RADIOGRAPHY: NEW IMAGING TECHNIQUE USING PENETRATING RADIATION. Jacobs, A. M.; Kenney, E. S. (Pennsylvania State Univ., University Park). pp 17-22 of Imaging Techniques for Testing and Inspection. Urbach, J. C. (ed.). Redondo Beach, CA; Society of Photo-optical Instrumentation Engineers (1972).

From meeting on imaging techniques for testing and inspection; Los Angeles, California, USA (14 Feb 1972). See CONF-720232-.

The general ideas embodied in the dynamic radiography technique are described, results of a simple demonstration experiment using gas-liquid flow are given, and some future applications are discussed. Although dynamic radiography is in a very early stage of development, all measurements so far accomplished have yielded results which indicate that it is a precision and sensitive imaging method with many applications. (LCL)

24133 IMAGING TECHNIQUES FOR LOW-FLUX NEUTRON RADIOGRAPHY. Swinth, K. L. (Battelle Northwest Labs., Richland, WA). pp 23-30 of Imaging Techniques for Testing and Inspection. Urbach, J. C. (Ed.). Redondo Beach, CA; Society of Photo-Optical Instrumentation Engineers (1972).

From meeting on imaging techniques for testing and inspection; Los Angeles, California, USA (14 Feb 1972). See CONF-720232-.

A number of direct imaging techniques were compared by analysis of radiographs, and density versus exposure curves were generated for the various techniques. Fiber optics face plates were used to improve the resolution of scintillator-produced neutron radiographs while calcium-tungstate scintillation screens were employed to enhance transfer radiographs. The use of gadolinium oxysulfide scintillation screens resulted in reduced exposure times compared to standard metal screens. (auth)

24134 IMPROVEMENTS IN SOLID STATE RADIOGRAPHIC CONVERTER SCREENS. Szepesi, Z. (Westinghouse Electric Corp., Elmira, NY). pp 31-37 of Imaging Techniques for Testing and Inspection. Urbach, J. C. (Ed.). Redondo Beach, CA; Society of Photo-Optical Instrumentation Engineers (1972).

From meeting on imaging techniques for testing and inspection; Los Angeles, California, USA (14 Feb 1972). See CONF-720232-.

During the last twenty years efforts have been made to develop solid state radiographic converters which could replace the fluoroscopic screen or radiographic film used in radiography. The working principles and present state of development of the two main kinds radiographic converter screens, the radiographic amplifier screen (R.A.S.) and the radiographic storage screen (R.S.S.), are described. The operating characteristics of the R.A.S. are compared with those of the fluoroscopic screen and the x-ray intensifier tube. Those of the R.S.S. are compared with Kodak type M radiographic film. It is concluded that R.A.S.'s most objectionable characteristic is its slow response which makes it unusable for detecting fast moving objects. However, it is light weight, easy to operate, and has better resolution, contrast, and brightness characteristics than the fluoroscopic screen or image intensifier tube. The great advantage of the R.S.S. over the photographic film is that the image can be seen during exposure so the operator can change the contrast to assure a satisfactory image. Possible uses of these radiographic converters in medical, industrial and military fields are listed. (LCL)

24135 ULTRASONIC ISOMETRIC IMAGING. Becker, F. L.; Trantow, R. L. (Westinghouse Hanford Co., Richland, WA). Contract AT(45-1)-2170. pp 61-65 of Imaging Techniques for Testing and Inspection. Urbach, J. C. (Ed.). Redondo Beach, CA; Society of Photo-Optical Instrumentation Engineers (1972).

From meeting on imaging techniques for testing and inspection; Los Angeles, California, USA (14 Feb 1972). See CONF-720232-.

An ultrasonic imaging technique has been developed which produces an isometric projection of three dimensional objects on a two dimensional display device. The technique has been demonstrated by apparatus which combines X, Y and time or Z axis information from conventional C-scan type devices into the X′ and Y′ axes of the display device. This arrangement provides a combination of depth and spatial information in a single record which can be easily interpreted. The controls may be adjusted to view the image from any perspective. By recording the test information on a tape loop and playing it back at high speeds, the operator can select the optimum perspectives for interpretation of unknown objects and flaws. Orthographic projections can also be made. Applications and demonstrations (including successful imaging in liquid sodium) are described which clearly indicate the advantages of the ultrasonic imaging technique over conventional B- and C-scans. The technique also has some advantages over scanned ultrasonic holography in that the entire object is in focus and more accurate depth resolution can be obtained. It could also be used to good advantage to complement the capabilities of holographic techniques. (auth)

24136 MEASUREMENT OF CAPSULE HEAT TRANSFER GAPS USING NEUTRON RADIOGRAPHY. Thaler, L. A. (Lewis Research Center, Cleveland). Mater. Eval.; 32: No. 3, 57-62 (Mar 1974).

The use of neutron radiographs to determine dimensional changes of heat transfer gaps in cylindrical nuclear fueled capsules is described. A high resolution neutron radiograph of the nuclear fueled capsule was obtained utilizing a beam of thermal neutrons from the NASA, 60 MW Plum Brook Reactor Facility. The neutron radiograph was scanned by a recording microdensitometer whose output was plotted on graph paper. The graphical representation of the light transmittance of the radiograph negative presented the heat transfer gap as a well-defined optical density change, with a maximum at the inner wall of the containment can and a minimum at the outer wall of the clad fuel pin. A value was obtained for each increment on the graph paper by calibrating the microdensitometer ratio arms using precision scales. Linear measurements between the maximum and minimum density were made from the traces using a 7X optical comparator with a scale divided in 0.0127 cm increments. Measurements using this technique agreed with physical measurements of the total heat transfer gap within ±0.005 cm over a range of gaps from 0.061 to 0.178 cm. This investigation was limited to less than 10% U-235 enriched uranium nitride fuel pellets in a hafnium–tungsten–tantalum alloy clad and sealed in a stainless steel can. Instrumentation, such as stainless steel sheathed thermocouples, was found to interfere with the measurements described if they were routed through the heat transfer gap area as seen on the neutron radiograph. (auth)

24137 DIGITAL SIMULATION IN RADIATION DEFECTOSCOPY OF INHOMOGENEOUS MATERIALS. Kivran, V. K.; Naats, I. E.; Parvatov, G. N.; Ses, V. I. (Tomsk Polytechnical Inst., USSR). Izv. Tomsk. Politekh. Inst.; 213: 105-107(1972). (In Russian).

The formulation of a mathematical model for concrete-type structures was examined. Concrete structures from the viewpoint of the distribution of coarse fillers can be represented by a random filling of gaps of the system with bodies having random dimensions, form, and orientation. These structures can be simulated by the Monte Carlo method. A mathematical model; developed on the M-20 computer and the results of the verification of its accuracy are reported. It is concluded that the good conformity with respect to the basic characteristics of the digital model developed for the granular inhomogeneous structure makes it possible to carry out the necessary calculation on the detectability of defects in bodies with this type of structure by radiation methods. (tr-auth)

24138 THEORY OF RADIATION FLAW DETECTION IN CONCRETE TYPE BODIES WITH INHOMOGENEOUS STRUCTURE. Vorob'ev, V. A.; Gavkalov, Yu. D. (Tomsk Polytechnical Inst., USSR). Izv. Tomsk. Politekh. Inst.; 213: 45-48(1972). (In Russian).

The basic status of the theory of radiation defectoscopy of concrete-type inhomogeneous materials and methods for the experimental investigation of the detectability of discontinuities in concrete are reported. Formulas are derived for the appearance of air voids, based on the change of the radiation intensity caused by defects. The characteristic fluctuations of the optical density of x-ray photographs during x-raying of concrete blocks with betatron bremsstrahlung are investigated. The data obtained can serve as the basis for the formulation of methods and design of radiation defectoscopy of iron–concrete construction under plant conditions and in construction areas. (tr-auth)

24139 DIGITAL SIMULATION IN RADIOGRAPHY FOR DENSITY CONTROL OF INHOMOGENEOUS MATERIALS. Vorob'ev, V. A.; Parvatov, G. N.; Ses, V. I. (Tomsk Polytechnical Inst., USSR). Izv. Tomsk. Politekh. Inst.; 213: 101-104(1972). (In Russian).

A digital simulation method is proposed for the investigation of the distribution of density along a sample by radiography. By means of the proposed model developed on the M-20 computer, the characteristics of the density of ingots of cement concrete are examined. From a comparison of the curves obtained by means of the digital model and of cement concrete samples it is concluded that in real concrete the distribution of coarse fillers in the sample conforms to the approximations obtained with the digital model. The use of the digital simulation method makes it possible to use the theory of random functions for the study of inhomogeneous structures and to give a mathematical model for the distribution of the density of coarse fillers in cement concrete. (tr-auth)

Nuclear Explosions

Refer also to abstracts 24215 and 24382.

24140 (AD-763489) LATE-TIME SOURCES FOR CLOSE-IN EMP (ELECTROMAGNETIC PULSES). Final Report, 3 May 1971–2 August 1972. Sargis, D. A.; Parkinson, E. R.; Wood, J. N.; Dietz, R. E.; Stevens, C. A. (Science Applications, Inc., La Jolla, Calif. (USA)). Aug 1972. Contract DASA01-71-C-0155. 323p. (SAI-72-556-LJ; DNA-3064-F). NTIS 3.00.

Calculations of ionization rates and electric currents in air and ground resulting from neutron sources are presented. In particular the numerical methods, nuclear data, and computer programs employed are presented and results for a typical thermonuclear neutron spectrum are given. A discussion of fitting of earlier electromagnetic pulse (EMP) source calculations is also presented. The latest ENDF/B neutron transport and gamma ray production data for air and ground are used and sensitivity of EMP calculations to cross section changes have been estimated. A new source energy band version of the Monte Carlo code 05RNIES has been developed which makes it possible to compute EMP sources by folding in various desired neutron spectra. New analytical approaches have also been introduced to accurately treat neutron capture events in air to times as late as one second. Analytical gamma-ray transport calculations away from the air-ground interface are used. Various neutron and gamma-ray contributions to ionization rates and electric currents have been tabulated as functions of fast and thermal reactions to assist in fitting of these quantities. (auth)

24141 (AD-766559-9) SEISMIC DISCRIMINATION. Semiannual Technical Summary Report No. 19, 1 January—30 June 1973. Davies, D. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 15 Aug 1973. Contract F19628-73-C-0002. 75p. (ESD-TR-73-175). NTIS $3.50.

Progress on both the short- and long-period constituents of the International Seismic Month is reported. Further work on understanding NORSAR's complexities is described. Evidence is given of the impact of lateral heterogeneity within the earth on seismic observations. The first work on evasion and counter-evasion problems is described. (auth)

24142 (AD-766857-7) LONG PERIOD SEISMIC METHODS FOR IDENTIFYING SMALL, UNDERGROUND NUCLEAR EXPLOSIONS. Final Report, 1 Jun 1969—31 March 1973. Alexander, S. S. (Pennsylvania State Univ., University Park (USA)). 22 Aug 1973. 166p. (AFOSR-TR-73-1603). NTIS $4.75.

The overall objective of this research has been to develop and test new methods for isolating diagnostic long-period information that can be used to distinguish small underground nuclear explosions from earthquakes. (GRA)

24143 (AD-766961-7) DISCRIMINATION AMONG SMALL MAGNITUDE EVENTS ON NEVADA TEST SITE. Peppin, W. A.; McEvilly, T. V. (California Univ., Berkeley (USA)). Aug 1973. 29p. (AFOSR-TR-73-1586). NTIS $3.00.

Broadband data (.02 to 20 Hz) from the University of California Lawrence Livermore Laboratory four-station seismic array, deployed at close range (less than 500 km) azimuthally about Nevada Test Site (NTS), allow investigation of the body wave-surface wave discriminant between explosion and earthquakes for small events confined to NTS, extending previous results to magnitudes around 3.5. It is found that natural earthquakes, explosion collapses, and explosion aftershocks all are distinct from explosions, and that the populations do not seem to converge at the low magnitudes. Also, for explosions, there is no change in the slope of the Pn versus Rayleigh wave amplitude relation over more than three orders of magnitude. Since the non-explosion events are shallow, of low magnitude, and of different source types, differences in source dimension, focal depth, and focal mechanism appear inadequate to explain the discriminant at small magnitudes. (auth)

24144 (AD-767565-5-GA) GROUND AND WATER SHOCK MEASUREMENT. Final Report. Report on Vela Uniform Project Long Shot, Project 1.01. Day, J. D.; Murrell, D. W. (Army Engineer Waterways Experiment Station, Vicksburg, Miss. (USA)). 24 Mar 1967. 83p. (VUF-2701). NTIS $6.25.

The final presentation of Vela Uniform Project 1.01 accomplished on the Long Shot test is presented. Primary objectives were to measure and analyze ground motions in the region above the detonation in light of effectiveness of containment, and to obtain ground-induced water shock measurements at close-in shoreline stations for possible correlation with injury to marine wildlife. A secondary objective was to compare and use (for protective structure purposes) the results of the ground motions with those obtained from other nuclear detonations in rock. These objectives are considered to have been fulfilled to large degree. Excellent ground motion records were obtained, both surface and downhole, and two of the four water stations produced good data. The weapon was successfully contained despite a surface zero transient displacement of 7.3 ft. The ground-induced water pressure at the close-in shoreline station was insufficient to injure marine wildlife. (auth)

24145 (AD-767878-2-GA) ESTIMATING THE EFFECT OF ASIAN EARTHQUAKE CODAS ON THE EXPLOSION DETECTION CAPABILITY OF LASA. Filson, J. R. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 13 Jul 1973. Contract F19628-73-C-0002. 43p. (ESD-TR-73-227). NTIS $3.00

A study was made of the short period detection characteristics of LASA within the codas of earthquakes occurring in the Kurile Island region and near the Kamchatka peninsula. The study yielded an estimate of the time interval that LASA would not detect an explosion in central Asia following an earthquake in either of the two seismic regions; this estimate is given as a function of earthquake-explosion magnitude difference. An attempt was also made to model the hypothetical cases where the explosions were collocated with the earthquakes in either the Kuriles or Kamchatka regions and estimates of the mask time intervals are given for these cases. The results of the experiments are extended in order to estimate the total time, during the decade 1961—1972, that an explosion of a given magnitude in either central Asia, the Kuriles, or Kamchatka would have gone undetected at LASA due to the seismicity of the latter two regions. This total mask time, under various assumptions, is quantified into separate time intervals in the cases where the explosions and earthquakes are collected. A result of this quantification is that, in the context of this experiment, there were a maximum of 300 two minute time intervals during the decade that a magnitude 5.0 explosion in the Kuriles might possibly have gone undetected at LASA, and 10 such intervals that the explosion most probably would have gone undetected, due to the seismicity of the Kurile Islands region. (auth)

24146 (AD-767888-1-GA) CODE FOR ANALYSIS OF NUCLEAR EFFECTS AND SYSTEMS SURVIVABILITY. Volume I. User's Guide. Meisterling, H. E. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio (USA). School of Engineering). Jun 1973. 42p. (GNE/PH-73-3(Vol.1)). NTIS $4.25.

Thesis.

The description of a computer code which calculates effects due to a nuclear burst, and determines the survivability of up to 100 selected vehicle positions is described. The effects calculated are those due to x-rays, neutrons, gammas, induced gamma, blast, and thermal. The code accepts as input; the number and spectra of the nuclear bursts; the vulnerability of the vehicles (one type at a time) to the various effects; and the mission profile (initial positions and velocity vectors). The code then computes the level of each effect from each burst at each target position. If any effect level exceeds the vehicle's given vulnerability, that vehicle is assumed to be killed. In the case of blast only a probability of survival may be computed rather than a kill/no kill determination. The code is written in FORTRAN Extended for the CDC 6600 computer located at Wright-Patterson Air Force Base, Ohio. The code requires 290 seconds of computer time for each burst to be analyzed, and a central core of 156,000 octal regardless of the number of bursts. The report is divided into five volumes. A user's guide to the code is presented. (auth) (GRA)

24147 (AD-767889-9-GA) CODE FOR ANALYSIS OF NUCLEAR EFFECTS AND SYSTEMS SURVIVABILITY. Volume II. Code Listing. Meisterling, H. E. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio (USA). School of Engineering). Jun 1973. 151p. (GNE/PH-73-3(Vol.2)). NTIS $9.75.

Thesis.

A computer code which calculates effects due to a nuclear burst, and determines the survivability of up to 100 selected vehicle positions is described. The effects calculated are those due to x-rays, neutrons, gammas, induced gammas, blast, and thermal. The code accepts as input; the number and spectra of the nuclear bursts; the vulnerability of the vehicles (one type at a time) to the various effects; the mission profile (initial positions and velocity vectors). The code then computes the level of each effect from each burst at each target position. If any effect level exceeds the vehicle's given vulnerability, that vehicle is assumed to be killed. In the case of blast only a probability of survival may be computed rather than a kill/no kill determination. The code is written in FORTRAN Extended for the CDC 6600 computer located at Wright-Patterson Air Force Base, Ohio. The code requires 290 seconds of computer time for each burst to be analyzed, and a central core of 156,000 octal regardless of the number of bursts. The report is divided into five volumes. Volume two presents a listing of the code and a brief description of each subroutine. (auth)

24148 (AD-767890-7-GA) CODE FOR ANALYSIS OF NUCLEAR EFFECTS AND SYSTEMS SURVIVABILITY. Volume IV. Neutrons and Gammas. McLaren, R. D.; Meisterling, H. E. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio (USA). School of Engineering). Jun 1973. 70p. (GNE/PH-73-3(Vol.4)). NTIS $5.50.

Thesis.

The description of a computer code which calculates effects due to a nuclear burst, and determines the survivability of up to 100 selected vehicle positions is described. The effects calculated are those due to x-rays, neutrons, gammas, induced gammas, blast, and thermal. The code accepts as input; the number and spectra of the nuclear bursts; the vulnerability of the vehicles (one type at a time) to the various effects; the mission profile (initial positions and velocity vectors). The code then computes the level of each effect from each burst at each target position. If any effect level exceeds the vehicle's given vulnerability, that vehicle is assumed to be killed. In the case of blast only a probability of survival may be computed rather than a kill/no kill determination. The code is written in FORTRAN Extended for the CDC 6600 computer located at Wright-Patterson Air Force Base, Ohio. The code requires 290 seconds of computer time for each burst to be analyzed, and a central core of 156,000 octal regardless of the number of bursts. A detailed description of the calculation of effects due to neutrons and gamma radiation is presented. (auth)

24149 (AD-767894-9-GA) CODE FOR ANALYSIS OF NUCLEAR EFFECTS AND SYSTEMS SURVIVABILITY. Volume V. X-Ray Effects. Meisterling, H. E. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio (USA). School of Engineering). Jun 1973. 49p. (GNE/PH-73-3(Vol.5)). NTIS $4.50.

Thesis.

The description of a computer code which calculates effects due to a nuclear burst, and determines the survivability of up to 100 selected vehicle positions is described. The effects calculated are those due to x-rays, neutrons, gammas, induced gammas, blast, and thermal. The code accepts as input; the number and spectra of the nuclear bursts; the vulnerability of the vehicles (one type at a time) to the various effects; the mission profile (initial positions and velocity vectors). The code then computes the level of each effect from each burst at each target position. If any effect level exceeds the vehicle's given vulnerability, that vehicle is assumed to be killed. In the case of blast only a probability of survival may be computed rather than a kill/no kill determination. The code is written in FORTRAN Extended for the CDC 6600 computer located at Wright-Patterson Air Force Base, Ohio. The code requires 290 seconds of computer time for each burst to be analyzed, and a central core of 156,000 octal regardless of the number of bursts. A detailed description of the calculations of effects due to x-rays is presented. (auth)

24150 (AD-768176-0-GA) EFFECT OF CONSTITUTIVE PROPERTIES OF EARTH MEDIA ON OUTRUNNING GROUND SHOCK FROM LARGE EXPLOSIONS. Final Technical Report, January 1972–June 1973. Hadala, P. F. (Army Engineer Waterways Experiment Station, Vicksburg, Miss. (USA)). Aug 1973. 476p. (AEWES-TR-S-73-6). NTIS $9.50.

Thesis.

Outrunning ground shock data from the 100- to 10-psi overpressure decade in six large surface high explosive (HE) tests, three from a rock site and three from a glaciated soil site, were analyzed for the effect of gross changes in constitutive properties. Axisymmetric wave propagation code calculations in layered linear and nonlinear (incrementally elastic-plastic) media were performed to determine the effects of introducing nonlinearity, selected material property variations, and the relative importance of airblast and direct induced effects from surface explosions in the overpressure decade of interest. (auth)

24151 (AD-768322-0-GA) EXTENDED ARRAY EVALUATION PROGRAM. Quarterly Report No. 4, 1 January–31 March 1973. Harley, T. W. (Texas Instruments, Inc., Dallas (USA)). 15 Apr 1973. 16p. NTIS $2.75.

24152 (AD-768323-8-GA) EXTENDED ARRAY EVALUATION PROGRAM. Quarterly Report No. 5, 1 April–30 June 1973. Harley, T. W. (Texas Instruments, Inc., Dallas (USA)). 13 Jul 1973. Contract F33657-72-C-0725. 15p. NTIS $2.75.

24153 (NVO-1163-240) OBSERVED SEISMIC DATA RIO BLANCO EVENT. (Environmental Research Corp., Las Vegas, Nev. (USA)). Mar 1974. AT(29-2)-1163. 57p. (PNE-RB-54). Dep. NTIS $5.45.

The Rio Blanco Event, a 30 Kt underground nuclear explosion detonated on 17 May 1973 in Colorado, was a government-industry natural gas stimulation experiment. Ground motion from the event was measured at 36 locations. Tabulated data are presented on the peak amplitudes, acceleration, velocity, and displacements due to the ground motion, surface geologic medium at the recording sites, arrival times, and pseudo-relative velocity spectra (PSRV) for each component of the ground motion at each station. Finally, pre-event predicted peak resultant vector amplitudes of acceleration, velocity, and displacement are compared with the Rio Blanco observed values and showed good agreement. (LCL)

24154 (PNE-G-85) GASBUGGY 1973 PRODUCTION TESTING. Chew, E. W.; Randolph, P. L. (El Paso Natural Gas Co., Tex. (USA)). 1973. 14p. (CONF-731101-55). Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

The 1973 Gasbuggy production tests were designed to determine what, if any, changes have occurred in the producing characteristics of the Gasbuggy chimney over a four-year period. In May 1973, gas production from the GB-ER well was resumed. A rapid drawdown of the chimney pressure from 736 psig to about 250 psig was completed in 23 d. A total of 71.4 M^2 ft^3 of gas was produced and flared in this part of the test. Flow rates ranged from 4.9 to 1.8 M^2 ft^3/d. The test continued by adjusting the flow rate so that the bottom-hole pressure would remain essentially constant. This part of the test ended on October 23, 1973. Another drawdown to 129 psig was completed on November 6, 1973. The pressures during 1973 production tests approximately duplicate those for the latter portion of the 1969 production tests. The drawdown data indicate that the chimney void volume is about the same as it was in 1969. This observation, in conjunction with the measured tritium content of water produced reveals that the amount of water, if any, entering the chimney since 1969 has averaged less than one-tenth of a gallon per minute. In addition, only amounts of water normal for its vapor pressure at the chimney temperature have been produced with the gas, confirming that the leak from the Ojo Alamo aquifer, which sealed itself in 1969, has not reopened. The radioactive concentrations in the gas have been continuously measured by the El Paso On-Line Monitor System, and by an E.P.A. burner. Maximum tritium and ^{85}Kr concentrations during drawdown were 0.236 and 0.066 μCi/SCF (at 15.025 psia and 60°F) respectively. Fresh gas flowing into the chimney region has since reduced these levels. The effect of influx near the top of the chimney was especially noticeable at the end of the drawdown when concentrations decreased by 50%. Tritium concentration in the separated water has remained at about 0.4 μCi/ml, equal to the November 1969 level corrected for radioactive decay. Surprisingly the liquid hydrocarbons separated from the gas also contain as much tritium as in 1969, now about 0.1 μCi/ml. The constant bottom-hole pressure portion of the production shows that no gross changes have taken place in the formation or in its permeability. Flow rates required to balance gas influx are somewhat less than those of 1969 due to the lower reservoir pressures. Computer modeling is required to accurately assess the results. The chemical composition of the natural gas produced has verified continued flushing of detonation-produced gases from the chimney as expected. Hydrocarbon plus hydrogen content has been 98%, while heating value has varied from 1160 to 1200 BTU/ft^3. (auth)

24155 (SC-TM-69-773) UNDERWATER MOTION AND OVERPRESSURES, MILROW EVENT. Preliminary Data Report. Merritt, M. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1969. 67p. Dep. NTIS $5.50.

Preliminary data derived from motion of the sea floor and from overpressures induced in the sea were obtained from five stations on the Milrow shot. Three component accelerations and velocities and pressures at various depths were measured. Data were obtained from almost all sensors. Peak vertical accelerations and velocities were generally a factor of 3 higher than predicted. Overpressures at the sea bottom are apparently strongly influenced by the depth of water, shallow water greatly reducing peaks to the point where the effects of water depth increasing with distance appear to override the expected decrease of peak pressures with distance. (auth)

24156 (SLA-74-24) EFFECT OF GEOLOGIC IRREGULARITIES ON SEISMIC RESPONSE. Murfin, W. B. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1974. Contract AT(29-1)-789. 43p. Dep. NTIS $4.25.

The finite element method is used to model a geologically diverse region in two dimensions. Responses are compared with those of horizontally uniform models for a variety of inputs. The distortion of short-period body waves is demonstrated to be highly influenced by local geologic irregularities, whereas surface waves and long-period body waves are relatively unchanged. Large areas of block faulting (typical of rift valleys) are shown to have paramount influence on seismic signals. (auth)

24157 (UCID-16110) CHIMNEY PERMEABILITY BY ATMOSPHERIC PRESSURE CHANGE: TEST START-UP. Snoeberger, D. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Oct 1972. Contract W-7405-eng-48. 16p. Dep. NTIS $3.00.

Permeability measurements in nuclear explosion chimneys are needed for the estimation of post-shot gas movements to minimize the release of radioactive materials. Preliminary calculations indicated that transient atmospheric pressure data obtained at the ground surface and at depth in a chimney would allow estimation of permeability by mathematical simulation of flow to match pressure at depth. Remotely operable instruments were installed at two chimneys in alluvium at the AEC Nevada Test Site and data obtained for depths near 600 ft over a period of several weeks. Sample data are given. The test is described for reference in connection with forthcoming calculational results. (auth)

24158 (UCID-16440) CHIMNEY PERMEABILITY DATA ANALYSIS. Rozsa, R. B.; Snoeberger, D. F.; Baker, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Jan 1974. Contract W-7405-eng-48. 21p. Dep. NTIS $3.25.

Analysis of atmospheric response data from three nuclear chimneys, DH3, DH5 and DH6, has been made using two different analytical solutions. A simple one-dimensional linearized model is used to predict the pressure response at depth in a chimney to surface pressure variations. Comparison of computed and measured downhole pressure histories shows a good fit over times of up to 25 days for all three chimneys. Assuming a nominal value of $\frac{1}{3}$ for porosity, the permeability in darcies is computed to be 63 for DH3, 12 for DH5, and 57 for DH6. (auth)

24159 (UCRL-51504) RIO BLANCO EXPERIMENT: SUBSURFACE AND SURFACE EFFECTS AND MEASUREMENTS. Toman, J.; Sisemore, C.; Terhune, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Nov 1973. Contract W-7405-eng-48. 17p. (PNE-RB-56). Dep. NTIS $4.00.

A major instrumentation program undertaken in the Rio Blanco experiment involved the burial of 20 accelerometers and 16 velocity gages at varying depths from the ground surface and distances from the emplacement well. The objective was to measure the extent of spall (tensile failure of the earth materials). A preliminary analysis of the accelerometer data indicates that the Rio Blanco spall zone can be described as a broad, shallow dish with a most probable depth of less than 350 ft and a radius less than 24,000 ft. Spalled material experiences a period of free fall (-1g acceleration) which can be identified in both acceleration and velocity traces. Acceleration records show conclusively that spall occurred above 149 ft at the emplacement well, but not below 604 ft. Instruments placed at depths of 350 and 450 ft appear not to have recorded spall characteristics, but these records must be analyzed in greater detail for a definitive statement. The results are in general agreement with predetonation predictions. (auth)

24160 SEISMIC SOURCE FUNCTION FOR AN UNDERGROUND NUCLEAR EXPLOSION. Aki, K.; Bouchon, M.; Reasenberg, P. (Massachusetts Inst. of Tech., Cambridge). Bull. Seismol. Soc. Amer.; 64: No. 1, 131-148(Feb 1974).

The reduced displacement potential obtained from close-in observation of seismic displacement during an underground explosion usually takes the form of a step function with or without a small overshoot. Theoretical prediction by shockwave calculation appears to agree with the close-in data. The step-function source has also been supported by the observations on Rayleigh waves at periods longer than 10 sec. Some inconsistency between the published data on residual potentials obtained from close-in data and those on seismic moments obtained from long-period Rayleigh waves were found. It appears that only about $\frac{1}{5}$ of the residual potential is transmitted to the far-field at long periods. This discrepancy is, however, consistent with several observations made on teleseismic signals suggesting an impulse rather than a step as the primary form of the potential function. New observations of the two NTS events at distances 2.6 to 7.8 km using wide dynamic range, wide-band accelerometers, combined with data from the far-field, support a large overshoot 4 to 5 times the residual value. This result accounts for the efficiency of the $M_s - m_b$ discriminant between earthquakes and explosions with m_b around 4 and greater. The compaction of the source volume by spalling was suggested as a possible mechanism for the large overshoot. (auth)

24161 STATISTICAL ANALYSIS OF LOW-RISE BUILDING DAMAGE CAUSED BY THE SAN FERNANDO EARTHQUAKE. Scholl, R. E. (John A. Blume and Associates, Engineers, Las Vegas, NV). Bull. Seismol. Soc. Amer.; 64: No. 1, 1-23(Feb 1974).

An empirical investigation of damage to low-rise buildings in two selected control areas within Glendale, California, caused by the ground motion precipitated by the San Fernando earthquake of February 9, 1971 is summarized. The procedures for obtaining the appropriate data and the methodology used in deriving ground motion-damage relationships are described. Motion-damage relationships are derived for overall damage and for the most frequently damaged building components. Overall motion-damage relationships are expressed in terms of damage incidence (damage ratio) and damage cost (damage cost factor). The motion-damage relationships derived from the earthquake data are compared with similar data obtained for low-rise buildings subjected to ground motion generated by an underground nuclear explosion. Overall comparison results show that for the same spectral acceleration, the earthquake caused slightly more damage. Differences in ground-motion characteristics for the two types of disturbances provide the most probable explanation for this discrepancy. (auth)

24162 GEODETIC DETERMINATION OF STRAIN AT THE NEVADA TEST SITE FOLLOWING THE HANDLEY EVENT. Savage, J. C.; Kinoshita, W. T.; Prescott, W. H. (National Center for Earthquake Research, Menlo Park, CA). Bull. Seismol. Soc. Amer.; 64: No. 1, 115-129(Feb 1974).

Repeated surveys of a trilateration network (aperture greater than 20 km) centered on ground zero for the HANDLEY event, a nuclear explosion at the Nevada Test Site with yield in excess of 1 megaton, suggest that the explosion induced an east–west extension of the network by more than 50 mm. In the year following the detonation, this deformation reversed such that the final configuration represented a small east–west contraction from the pre-HANDLEY state. In the subsequent 2-year period, only minor deformation was detected. Thus, the overall response of Pahute Mesa may be described as stable. The explosion-induced deformation is thought to be partly due to slip on faults driven by the large-amplitude seismic waves from the explosion. The mechanism of the postshot relaxation is not understood. (auth)

24163 ANOMALIES OBSERVED IN FRANCE CONCERNING THE PROPAGATION DURATION OF P WAVES DURING UNDERGROUND NUCLEAR EXPLOSIONS IN THE ALEUTIAN ISLANDS. Baltenberger, P.; Labrouste, Y.; Mechler, P. (Centre National de la Recherche Scientifique, Garchy, France). Compt. Rend., Ser. D; 277: No. 16, 1625-1628(22 Oct 1973). (In French).

A table is given of anomalies observed in France concerning the propagation of P waves from underground explosions in the Aleutian islands. The delays of the order of 1 s occurring in the volcanic regions of the Massif Central in relation to ancient crystalline rock formations (Normandie, Marche, Morvan, Vosges, and the Black Forest) are emphasized. (FR)

Protective Structures and Equipment

24164 (HASL-280) EVALUATION OF ACTIVATED CARBON CANISTERS FOR RADON PROTECTION IN URANIUM MINES. Thomas, J. W. (USAEC Health and Safety Lab., New York). Jan 1974. 31p. Dep. NTIS $4.00.

The protection against radon gas afforded by several types of activated carbon gas mask canisters was determined, since uranium mine personnel are occasionally exposed to radon concentrations in the thousands of pCi/l range, and calculations showed that 3300 pCi/l of radon was equivalent to the permissible level of 0.3 WL of radon daughters on the basis of potential alpha energy release in the respiratory tract. The canisters were tested at radon concentrations from about 1500 to 40,000 pCi/l and flow rates from 8 to 64 l/min. Other variables studied were test air humidity, water content of the carbon, and temperature. Results indicated that a canister containing about 900 ml of dry, high-grade activated carbon, used at a breathing rate of 16 l/min, would provide almost 100% protection against radon for a period of one hour at a temperature of 25°C and an air humidity of about 9 mg/l. Protection would be provided for a longer period at the lower temperatures existing in uranium mines. (auth)

24165 (LCA-N-235-E-T) RADIOPROTECTION CALCULATION FOR AN IRRADIATION CHAMBER. Marquie, M. (Laboratoire Central de l'Armement, 94–Arcueil (France)). 19 Mar 1973. 24p. (In French). Dep. NTIS (U. S. Sales Only) $3.25.

The results of calculations made using the Monte Carlo method to evaluate the thickness of the walls and roof of an irradiation chamber containing 3000 Ci of ^{137}Cs and 20 Ci of ^{60}Co in order to conform with radioprotection norms are presented. (FR)

24166 (RT/ING-(73)16) FIRE PROTECTION IN THE PLUTONIUM HOT LABORATORY IN THE CENTER FOR NUCLEAR STUDIES AT CASACCIA. Busoni, L.; Da Rold, A.; Evangelisti, R.; Migliorini, R.; Ciarabolini, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 11 Oct 1973. 27p. (In French). (CONF-730667-6). Dep. NTIS (U. S. Sales Only) $3.50.

From 15th meeting of the committee on hot laboratories of Euratom; Geesthacht, F.R. Germany (14 Jun 1973).

Equipment designed for fire extinction in the plutonium hot cells laboratory at Casaccia Center is described. Besides the problems related to the fire detection, fire alarms, and extinction are examined. (auth)

24167 INVESTIGATION OF THE PROTECTIVE PROPERTIES OF EYE-SHIELDS FOR TELE-GAMMA-THERAPEUTIC ^{60}Co BY A THERMOLUMINESCENT METHOD. Studencki, E.; Maslovaric-Jablonska, K.; Cisowska-Pakula, B.; Fajndt, S. (Inst. of Oncology, Lodz, Poland). Postepy Fiz. Med.; 7: 25-31(1972). (In Polish).

Different kinds of eye-shields used for protection of eyes during oncological therapy are described. The results of measurements of the protective properties of these shields with the aid of thermoluminescent dosemeters are discussed. (auth)

Safety Engineering

Refer also to abstract 24597.

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstract 24343.

24168 (AEC-tr-7508) MOUNANA URANIUM DEPOSIT. Morin, N.; Tardieu, Y. Translated from Ind. Miner., Mine; 21-32(1972). 23p. Dep. NTIS $3.25.

The Mounana uranium deposit, which is principally a sandstone deposit near Franceville in Gabon, is described in detail. Information is included on: location and size of deposit; geologic formation; stratigraphy; petrography; mineralization with uranium- and vanadium-bearing ores; tectonics; and distribution of mineralization. (LCL)

24169 (CEA-R-4407) PETROGRAPHIC AND GEOCHEMICAL INVESTIGATIONS ON GRANIES OF THE URANIFEROUS DISTRICT OF VENDEE (FRANCE): RELATIONS BETWEEN URANIUM AND MINERALOGICAL EVOLUTION: CONSEQUENCES FOR PROSPECTION. Renard, J. P. (CEA Direction des Productions, 92, Chatillon (France)). Feb 1974. 216p. (In French). Dep. NTIS (U.S. Sales Only) $13.00.

Thesis. Presented to Univ., Nancy (France).

The uraniferous district of Mortagne-sur-Sèvre (Vendée, France) was studied with regard to its structural, chemical and mineralogical features. Methods adapted result in the description of mainly the chemical and mineralogical evolution of the massive of Mortagne; the uranium bearing association in granites and their associated micas; the geochemical process including mobilization of primary uranium in relation to mineralogical differentiation; the endogenetic processes of uranium removal from micas, which provide an explanation for the ore bearing granites; the comparable behavior of uranium, tin, tungsten and rare alkalis metals. The evolutionary processes described important metallogenic consequences; ore concentrations are present where biotites are deeply transformed. Practical consequences of mobilization processes are given to serve as guides during strategic and tactical prospections. (auth)

24170 (GJO-912-16) GEOCHEMICAL INVESTIGATIONS OF PLUTONIC ROCKS IN THE WESTERN UNITED STATES FOR THE PURPOSE OF DETERMINING FAVORABILITY FOR VEIN-TYPE URANIUM DEPOSITS. Marjaniemi, D. K.; Basler, A. L. (Pitkin (Lucius), Inc., Grand Junction, Colo. (USA). Western Uranium Project). 15 Dec 1972. Contract AT(05-1)-912. 216p. Dep. NTIS $13.00.

Reconnaissance geochemical investigations of plutonic rocks in the western United States were undertaken for the purpose of determining geochemical guides and favorable areas for vein-type uranium deposits. Gamma ray spectrometric analyses for uranium, thorium, and potassium and semiquantitative emission spectrographic analyses were obtained on approximately 500 samples collected from throughout the western U. S. Quantitative major-element analyses were obtained on selected samples. The regional variations of uranium, thorium, and potassium concentrations in plutonic rocks were investigated on the basis of average values for one-degree latitude-longitude quadrilaterals and average values and frequency distributions for geologic subdivisions. The results in both cases indicate a general decrease in the concentrations of the three elements from the continental interior to the continental margin. Geologic subdivisions with the highest average uranium content are (a) the Northern Rocky Mountain batholiths of eastern Washington and northern Idaho, (b) the Idaho-Boulder batholiths, (c) the Southern Rocky Mountains of Colorado, and (d) the Mexican Highland of southeastern Arizona and southwestern New Mexico. Geologic subdivisions with the lowest average uranium values are the Columbia Plateau and the Colorado Plateau. Subdivisions containing major known vein-type uranium deposits are not necessarily characterized by high average uranium content. Possible geochemical guides for vein-type uranium deposits were determined from comparisons of chemical data for samples from plutonic bodies associated with known deposits and all samples from the western U. S. or selected groups of samples. The results indicate that plutonic bodies associated with known vein deposits are characterized by very high silicon, high aluminum, potassium, rubidium and Nockolds-Allen differentiation index, a limited range of values of the ferric to total iron ratio, low sodium, calcium, titanium, manganese, and phosphorus, very low iron and vanadium, and a high range of values of the uranium-potassium ratio. Uranium and thorium concentrations and the uranium-thorium ratio are commonly but not always higher in the plutonic bodies associated with vein deposits. Of the various chemical elements and indices considered the best possible indicators are the Nockolds-Allen index, potassium, silicon, the ferric-total iron ratio, and the uranium-potassium ratio. Uranium content is not useful as an indicator on a continental scale but it may be useful on a local or regional (geologic province) scale. Results indicate that plutonic bodies associated with known vein-type uranium deposits are characterized by unique geochemical abundances and relationships and that the determination of geochemical guides and favorable areas for vein-type uranium deposits is possible. (auth)

24171 (STI/PUB-334) URANIUM EXPLORATION METHODS. Panel Proceedings Series. Proceedings of a Panel Held in Vienna, Austria, April 10–14, 1972. (International Atomic Energy Agency, Vienna (Austria)). Nov 1973. 326p. (In Spanish and English). (CONF-720487-). IAEA $15.00.

Fifteen papers were presented at the conference. A separate abstract was prepared for each paper. (LCL)

For abstracts of individual papers see: 24172–24184, 24342, and 24343.

24172 URANIUM EXPLORATION POLICY, ECONOMICS, AND FUTURE PROSPECTS. Nininger, R. D. (Atomic Energy Commission, Washington, DC). pp 3-17 of Uranium Exploration Methods. Vienna; International Atomic Energy Agency (1973).

From panel on uranium exploration methods; Vienna, Austria (10 Apr 1972). See STI/PUB-334; CONF-720487-.

Presently known low-cost uranium reserves are about equal to anticipated requirements into the 1980s. Intensive exploration will be necessary to meet the increasing demand later in this century. World-wide exploration has declined in most areas as a consequence of low uranium prices, but long lead times and uncertainties concerning exploration success indicate the need to resume vigorous exploration soon. The uncertainty is emphasized by the fact that only about 20 areas of the world have so far been found to contain deposits of a size that is economically attractive. The magnitude of the effort needed is emphasized by the fact that several thousand million dollars must be spent in the remainder of this century in exploration for uranium which will have a value in the tens of thousands of millions of dollars. Many potentially favorable areas remain to be explored, and a number of the less developed countries have undertaken or are considering uranium exploration programs. The money and technical manpower required often make it attractive for developing countries to use assistance from IAEA, from other countries, or from private companies as concessionaires, contractors, or as partners. In every case, it is desirable to have an indigenous geological staff capable of evaluating developments and providing technical advice to the government. Uranium exploration programs are more likely to be successful if they are oriented towards identification and evaluation of resource areas containing at least several thousand tons of uranium. Exploration teams using a number of skills and sophisticated equipment can assess large regions and selectively reduce targets to drilling projects of a few hectares. Such exploration programs may cost $1 million annually for several years. Total capital investment of around $20 million and a period of 8 to 10 years may be required for a successful project from inception to production. Details of typical exploration programs and costs are described. (auth)

24173 SPAIN'S URANIUM EXPLORATION PROGRAM: DEVELOPMENT OF TECHNIQUES AND METHODS. Martin-Delgado Tamayo, J.; Arteago Rodriguez, R.; Fernandex Polo, J. A. (Junta de Energia Nuclear, Madrid). pp 23-30 of Uranium Exploration Methods. Vienna; International Atomic Energy Agency (1973). (In Spanish).

From panel on uranium exploration methods; Vienna, Austria (10 Apr 1972). See STI/PUB-334; CONF-720487-.

In the light of aims formulated by the IAEA at its Panel on Uranium Exploration Methods, it was thought that it would be of considerable interest to describe Spain's experience in developing exploration programs from the initial stages to the present planning stage. The gradual changes in the guidelines followed in prospecting for radioactive ores have resulted from the experience gained in Spain and in other countries, due regard being paid to geological conditions in Spain, the facilities available, and the peaceful uses of this source of energy. These changes have affected the way in which each exploration technique is used (leading to rationalization in the co-ordinated use of different techniques), the scientific considerations underlying the work and the structure and basic organization of the departments involved in uranium exploration. Significant information is presented on radiometric prospecting (airborne, carborne and on foot), geochemical prospecting, surface studies and studies carried out by means of boreholes, probes and shafts. The main features of Spain's present program and its four-year plan for the immediate future are also described. (auth)

24174 SOME ASPECTS CONCERNING THE FEASIBILITY OF RADIOMETRIC METHODS FOR URANIUM EXPLORATION IN FINLAND. Ketola, M.; Sarikkola, R. (Outokumpu Co., Tapiola, Finland). pp 31-43 of Uranium Exploration Methods. Vienna; International Atomic Energy Agency (1973).

From panel on uranium exploration methods; Vienna, Austria (10 Apr 1972). See STI/PUB-334; CONF-720487-.

The feasibility of the survey methods employed for uranium exploration is restricted by Finland's geographical location, as well as by its vegetation, waterways, and soil. Systematic exploration for uranium has been carried out on a rather small scale, and has been concentrated mainly on extensive quartzite areas. The search for boulders, a method in which the boulders loosened from the bed rock by glacier ice or frost are traced and used for the localization of the outcropping mineralization, has shown its validity both in ore and uranium exploration. The feasibility of employing ground and airborne radiometric methods as well as radon determinations is evaluated. The results obtained by ground methods are reported in the light of the Kesiinki case-history. (auth)

24175 EXPLORATION OF URANIUM DEPOSITS IN TERTIARY CONGLOMERATES AND SANDSTONES IN JAPAN. Kamiyama, T. (Power Reactor and Nuclear Fuel Development Corp., Tokyo); Okada, S.; Shimazaki, Y. pp 45-54 of Uranium Exploration Methods. Vienna; International Atomic Energy Agency (1973).

From panel on uranium exploration methods; Vienna, Austria (10 Apr 1972). See STI/PUB-334; CONF-720487-.

In Japan there are two uranium mines, the Ningyo-toge mine and the Tono mine, which occur as penecordant uranium concentrations in the basal part of Neogene formations immediately overlying a Mesozoic granitic basement. The uranium concentrations occur in the depressions of the granite surface which are considered to be former river channels. These deposits were discovered as a result of an extensive carborne radiometric survey designed to cover the entire country; subsequent exploration employed various methods. Detailed mapping coupled with geophysical methods provided data on the extent of the ore-bearing horizons and the topography of the basement surface. Drilling was carried out quite extensively. A large-size-diameter mud fluid method was applied to produce maximum core recovery and succeeded in obtaining perfect core samples even in loose sedimentary rock. Exploratory tunnelling proved the final dimensions and the grade of the ores. On the other hand, basic studies of the geochemistry and mineralogy of the ores, and of the petrology of the granitic rocks which are considered to be the source of the uranium, proved invaluable for exploration, since they yielded detailed understanding of the nature of the deposit and the ores. A case history of the exploratory work of one of these deposits, which is essentially a combination of more or less orthodox methods, is presented, together with discussion of the various phases of the project. (auth)

24176 METHODS, TRENDS AND REQUIREMENTS IN URANIUM EXPLORATION. Bowie, S. H. U. (Inst. of Geological Sciences, London). pp 57-65 of Uranium Exploration Methods. Vienna; International Atomic Energy Agency (1973).

From panel on uranium exploration methods; Vienna, Austria (10 Apr 1972). See STI/PUB-334; CONF-720487-.

A prerequisite of well-planned reconnaissance programs is sound geological knowledge of the region under consideration. However, geological electronic techniques as well as those of geochemistry and geobotany all have a role to play in the discovery of uranium ore bodies. As the more accessible parts of the earth's crust are surveyed, more emphasis will be placed on aero-reconnaissance techniques capable of defining large, favourable though relatively inaccessible, areas and of detecting hidden ore bodies. Suggestions are made as to requirements and likely trends in the development of the more orthodox techniques as well as to relatively untried and novel search methods. (auth)

24177 AIRBORNE GAMMA-RAY SURVEY TECHNIQUES: PRESENT AND FUTURE. Darnley, A. G. (Geological Survey of Canada, Ottawa). pp 67-108 of Uranium Exploration Methods. Vienna; International Atomic Energy Agency (1973).

From panel on uranium exploration methods; Vienna, Austria (10 Apr 1972). See STI/PUB-334; CONF-720487-.

There are a variety of spectrometer systems available for commercial use. To use them in the most effective way it is necessary to consider the problems involved. Districts containing uranium mineralization generally fall within or on the margin of regions containing above-average abundances of all the radioelements. These radioactive regions can be readily found by airborne surveys, which measure only total radioactivity. Sometimes the mineralization controls within an area may be so well known that it is unnecessary to use spectrometer systems. In general it is advantageous to use the discriminating ability of a spectrometer to identify anomalies containing significant amounts of uranium. This selection of anomalies is most essential wherever the costs of ground work are high. The most sensitive spectrometers available are capable of measuring the mean ground level abundances of potassium, uranium and thorium, which can be expressed in conventional units of concentration. From an exploration viewpoint the most important parameters that can be measured are the relative concentrations of uranium to thorium and uranium to potassium. These are diagnostic for identification of zones of anomalous uranium concentration. Good counting statistics are essential to obtain meaningful ratio measurements. These are obtained by maximizing detector volume and minimizing ground speed of the aircraft. Minimizing flight elevation improves sensitivity for small area targets, but it entails closer line spacing for a given percentage coverage of an area. As a general principle, airborne gamma surveys should be aimed primarily at finding target zones with linear dimensions of the order of hundreds or thousands of meters, where the mean enrichment of uranium at the surface may be only one or two parts per million higher than the surroundings. It can be shown that high-sensitivity equipment is most cost-effective for this purpose. The availability of fully corrected data, with a comprehensive display of all the parameters in profile and map form, is essential to extract maximum value from a survey with such equipment. (auth)

24178 PRACTICAL APPROACH TO URANIUM EXPLORATION DRILLING FROM RECONNAISSANCE TO RESERVES. Davis, J. F. (Union Pacific Mining Corp., Denver). pp 109-123 of Uranium Exploration Methods. Vienna; International Atomic Energy Agency (1973).

From panel on uranium exploration methods; Vienna, Austria (10 Apr 1972). See STI/PUB-334; CONF-720487-.

The use of the drill rig early in uranium exploration, assisted by sophisticated geochemical and geophysical techniques, has led to a relatively unusual mineral exploration procedure. The drill is used in sedimentary-type uranium exploration to provide not only mineralization information, but stratigraphic, alteration, and other data that is not evidenced by surface expression. Portable drill rigs capable of drilling over 600 m per shift permit a total exploration cost of less than \$10/m. In the United States of America this type of exploration, guided primarily by continuing geological analysis, has led to the discovery of large amounts of uranium at a cost of less than \$2/kg. The use of conceptual models based on known districts and the geochemical characteristics of uranium provide the framework for the initial exploration phase. The exploration techniques of a drilling program require emphasis on careful, but not unnecessarily detailed, geological analysis. The size and grade of a minimum necessary target can govern the detail required as well as the exploration budget. (auth)

24179 EXPLORATION FOR URANIUM IN SANDSTONES: GEOCHEMICAL, REMANENT MAGNETIC, AND SULPHUR-ISOTOPE APPLICATIONS. Adler, H. H. (Atomic Energy Commission, Washington, DC). pp 155-169 of Uranium Exploration Methods. Vienna; International Atomic Energy Agency (1973).

From panel on uranium exploration methods; Vienna, Austria (10 Apr 1972). See STI/PUB-334; CONF-720487-.

For several years, forecasts of uranium requirements to meet projected demands for nuclear energy has indicated the need for intensification of exploration. Research is needed to improve ore discovery prospects and to develop a more favourable ore resource situation. Most of the uranium ore mined in the United States of America has been deposited at reduction-oxidation interfaces in fluviatile sandstones as a result of oxidation of pyritic carbonaceous facies. The ore-forming process produces large tongues of oxidative alteration which extend from the surface downward to the reduzate facies. Radioactivity and spotty mineralization at the surface reflect the presence of ore bodies at depth, but where these manifestations are absent other characteristics measurable in the outcrop of red or drab sandstones may be useful in evaluating favourability for ore. Natural remanent magnetic properties, such as anomalous pole orientations or absence of remanent magnetism in Eocene or older fluviatile red-bed sandstones, may conceivably reflect relatively recent oxidation leading to ore formation at depth. The observed absence of magnetite and maghemite in presently oxidized sandstone can be attributed to reduction or leaching of these iron oxides by ore-forming processes. Unusually negative $\delta\,^{34}S$ values for sulphate sulfur in surficial gypsum, whole-rock samples or groundwater may indicate the presence at depth of ^{32}S-enriched pyrite with which uranium deposits are associated. Prudent and skilful appraisal and use of these properties coupled with a modest research effort to determine their limitations may yield rewarding dividends in extending the search for uranium into unexplored regions. (auth)

24180 SOME ASPECTS OF GEOCHEMICAL SURVEYS FOR URANIUM. Ostle, D.; Ball, T. K. (Inst. of Geological Sciences, London). pp 171-187 of Uranium Exploration Methods. Vienna; International Atomic Energy Agency (1973).

From panel on uranium exploration methods; Vienna, Austria (10 Apr 1972). See STI/PUB-334; CONF-720487-.

A review of the geochemistry of uranium in the supergene environment is given in relation to geochemical prospecting. The effects of particular chemical factors complicating the interpretation of prospecting data are discussed, including those of bicarbonate sulphate and chloride complexes, organic material, sesquioxide complexes and phosphate precipitates. Present sampling and analytical methods are discussed and conclusions drawn as to the relative merits of stream-water, stream-sediment and soil sampling. Future progress is believed to rely on adequate dissemination of the results of geochemical surveys and on a better understanding of interpretative problems. (auth)

24181 GEOCHEMICAL EXPLORATION FOR URANIUM. Dall'Aglio, M. (CNEN, Rome). pp 189-208 of Uranium Exploration Methods. Vienna; International Atomic Energy Agency (1973).

From panel on uranium exploration methods; Vienna, Austria (10 Apr 1972). See STI/PUB-334; CONF-720487-.

Geochemical methods can be of great help in all the working stages of mineral exploration. In the last decade, in fact, geochemical prospecting has also been widely applied to uranium ore exploration. The results obtained have not always fulfilled the expectations, although a complete assessment is not easy to make. This is due to various causes, organizational as well as technical, but the experience gained, though negative in part, has to be put to use in rationally planning future research. Geochemical methods can play an indispensable role especially in the exploration surveys carried out in countries little studied from a geological and minerogenetic viewpoint, as, for instance, in the developing countries. In particular, in planning the application of the various geochemical techniques of exploration, one must keep in mind the following characteristics of this method: polymetallic surveys are the most logical and convenient type of application of geochemical exploration; each of the various geochemical techniques must be employed using a sampling grid density proportioned to the dimensions of the various types of the dispersion haloes. In particular, the best application of geochemical exploration is in large-scale surveys; and geochemical prospecting is an essentially direct exploration technique. The data one gets from the geochemical surveys can provide the most logical link between ore genesis and exploration. The above topics are discussed in detail. Particular emphasis is given to the planning and interpretation stages of surveys, and to the use of automatic data processing. In addition some case histories of polymetallic geochemical surveys are given. (auth)

24182 HYDROGEOCHEMICAL RECONNAISSANCE PROSPECTING. Fauth, H. (Bundesanstalt fuer Bodenforschung, Hanover). pp 209-218 of Uranium Exploration Methods. Vienna; International Atomic Energy Agency (1973).

From panel on uranium exploration methods; Vienna, Austria (10 Apr 1972). See STI/PUB-334; CONF-720487-.

Hydrogeochemical reconnaissance prospecting by the chemical determination of uranium in springs, streams and wells has the advantage that it can indicate uranium enrichments not only at the surface but also at depth. By modifying the procedure, this method was so improved as to be quicker and cheaper than airborne and carborne prospecting. The water samples are collected in 2-litre polyethylene bottles and are analysed in the laboratory trailer by the following method: precipitation of the uranium by ferric hydroxide; separation from the disturbing elements by tributyl-phosphate; and determination of the uranium using a cathode-ray polarograph. About 70 to 90 analyses can be made per man and working day. Depending on the number of samples (max. 300/d) the mobile laboratory must be operated by one to four people of whom at least one must be an assistant chemist. The laboratory costs per sample is about US $1. The costs of sampling depend mainly on conditions in the survey area, $1.0 per sample under the most favourable, $10.0 under the least. Uranium prospecting in the Black Forest (Schwarzwald), Federal Republic of Germany, is given as a detailed example. So far, about 30,000 samples, collected in the Federal Republic, Peru, Mali, Togo, Ghana, Mozambique, Angola and other countries, have been analysed by this method. The method has worked very well under the most difficult climatic and terrain conditions and has been perfected for prospecting in developing countries. (auth)

24183 STUDY OF THE BEHAVIOR OF RADON IN SOIL. Bhatnagar, A. S. (Dept. of Atomic Energy, New Delhi). pp 219-236 of Uranium Exploration Methods. Vienna; International Atomic Energy Agency (1973).

From panel on uranium exploration methods; Vienna, Austria (10 Apr 1972). See STI/PUB-334; CONF-720487-.

Measurements of radon were made over widely separated areas. The fluctuations were statistically studied. Values over some areas arranged themselves in a single lognormal distribution while in some others the data resolved itself in two distinct lognormal distributions when plotted on probability paper. Geologically the areas showing a single distribution are known to be unmineralized. Those showing a double distribution are found to be mineralized and contain varying uranium enrichment though not of any economic value. As in the mining industry, an attempt has been made to see if the two types of distributions are related to the nature of mineralization. No generalization can be made at this stage, and further studies are in progress to confirm if any such correlation really exists. An experiment to test the results was made by injecting radon in one of the holes and taking measurements in the surrounding holes. (auth)

24184 RADON MEASUREMENT IN URANIUM PROSPECTING. Miller, J. M.; Ostle, D. (Inst. of Geological Sciences, London). pp 237-247 of Uranium Exploration Methods. Vienna; International Atomic Energy Agency (1973).

From panel on uranium exploration methods; Vienna, Austria (10 Apr 1972). See STI/PUB-334; CONF-720487-.

The nature and origin of the three naturally occurring radon isotopes is discussed together with the processes by which they migrate from the parent mineral through rock, soil, and water. Attention is drawn to the effects of migration of soil profile, ground saturation and meteorological conditions and to the factors affecting the occurrence of radon in lakes and streams. Details are given of the methods used to detect radon in soil and water and a survey made of instruments currently in production. These include probe and pump-type monitors with alpha-sensitive phosphors, and ion chamber detectors. Considerations governing the use of radon measurement as a primary and secondary uranium prospecting technique are presented and examples are given of radon in soil surveys carried out in the United Kingdom. Progress in the future will rely on operational experience in different environments and modifications to specific features of instrumentation suggested by local needs. (auth)

24185 UTILIZATION OF OUR MINERAL RESOURCES: ARE WE MEETING THE CHALLENGE. Queneau, P. E. (Univ. of Minnesota, Minneapolis). Prof. Eng.; 44: No. 3, 28-29(Mar 1974).

The wealth of native mineral resources in the U. S. is now measured by extractive methods and technology and not by reserves in the ground. Obsolescence in the industry is discussed. An examination was made of three conclusions reached from the Mining and Minerals Policy Act of 1970 by the Secretary of the Interior. Development, wise use, and recycling of the mineral resources of the U. S. are requisites to alleviate the reliance upon foreign sources of minerals. Processes by which fuels are converted to energy and metallic ores to useful metals are prime polluters, and these processes must be modified or alternate processes adopted. Research and education in most fields of mineral science are lagging and the gap is widening. Legislation and financial incentives for private enterprise to engage in research are necessary to slacken the technological slide. (MCW)

Radioactive Effluents

Refer also to abstracts 24386, 24477, 26175, 26177, 26191, 26194, 26320, 26325, 26335, 26338, and 26343.

24186 (BNWL-SA-3967) PLUTONIUM IN SURFACE SOIL IN THE HANFORD PLANT ENVIRONS. Corley, J. P.; Robertson, D. M.; Brauer, F. P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Aug 1972. 11p. Dep. NTIS $3.00.

Analyses for plutonium in air, water, and foodstuffs have long been part of the routine surveillance program at Hanford. In addition, the ground and other surfaces have been surveyed for plutonium where there was possible deposition from stack emissions, waste spills, etc., using direct instrument measurements. Detectable plutonium deposition from the few such incidents has been confined to restricted areas. The surface contamination level that can be detected with the portable instruments is approximately 0.007 μg Pu per 100 cm^2. The desire to obtain additional information regarding any spread of Pu beyond the restricted areas, as well as to distinguish between any Pu in soil resulting from plant activities and that resulting from fallout led to a screening survey for plutonium in surface soils both on and off-site in February 1970. The results to date and the procedures followed are discussed. The limited amount of subsequent data has given results within the same range of Pu concentrations. (auth)

24187 (HW-25575) COULEE DAM DISASTER EFFECTS ON HANFORD WORKS: RADIOLOGICAL SCIENCES DEPARTMENT VIEWPOINT. Healy, J. W.; Smith, J. M. (Hanford Works, Richland, Wash. (USA)). 9 Sep 1962. 9p. Dep. NTIS $3.00.

A study was made of the radiological problems connected with the flooding of the Hanford Works area due to a break in the Coulee Dam. Subjects considered include: reactor hazards resulting from failure of reactor structure or failure of cooling water; damage to radioactive material storage areas; release of radioactive wastes contained in retention basins, cribs, and burial grounds; and release of radioactive materials kept in research laboratories. It was concluded that: the mechanical failures of the pile structure and/or the release of piles materials resulting from cooling water failure far outweigh all other possible hazards and present a regional radiation problem of the first magnitude; assuming the absence of that hazard, the downstream distribution of irradiated metal from storage basins, transfer cars, and laboratories would be of importance; assuming control of both of these classes of hazards, the washing out of burial ground contents and contamination of river water from the miscellaneous sources would present control problems. Radiation monitoring procedures to be used during and after the flood and hazard prevention measures are mentioned. (LCL)

24188 (INIS-mf-887, pp 141-153) CONTAMINATION OF ATMOSPHERE WITH RADIOACTIVE GASES RESULTING FROM NUCLEAR POWER GENERATION. Wardaszko, T. (Centralne Lab. Ochrony Radiologicznej, Warsaw). [nd]. (In Russian).

Risks are discussed of the atmospheric contamination with radioactive gases and a brief review is presented of the radioactive gases and their behavior resulting from the operation of nuclear power reactors and of reprocessing plants. Discussed in more detail is the contamination of the atmosphere with ^{85}Kr and tritium. (INIS)

Radioactivity Monitoring and Transport

Refer also to abstracts 24187, 24230, 24234, 24291, 24477, 25980, 26194, 26320, 26335, and 26338.

24189 (INIS-mf-887, pp 114-127) CONTAMINATION OF ENVIRONMENT WITH ^{90}Sr AND ^{137}Cs FALLOUT. Usacev, S. (Komenskeho Univerzita, Bratislava, Czech.). [nd]. (In Slovak).

The artificial contamination of the environment resulting from the operation of nuclear power plants is discussed and the respective aerosols in question are characterized. A review is presented of the methods of activity measurement and environmental monitoring. (INIS)

24190 (INIS-mf-887, pp 196-203) SIGNIFICANCE FOR RADIATION HYGIENE OF MONITORING THE ENVIRONMENTAL CONTAMINATION WITH TRITIUM. Kollar, J.; Chorvat, D.; Tatara, M.; Szlaurova, M.; Trnovec, T. (Vyskumny Ustav Hygieny Prace a Chorob z Povolania, Bratislava). [nd]. (In Slovak).

The occurrence and the sources of tritium in the environment are reviewed and the estimated increase in the tritium concentration in the future is discussed. The effects of tritium on the human organism are dealt with and a method is described used by the Institute of Industrial Hygiene and Occupational Diseases, Bratislava, of determining and monitoring the natural concentration of tritium in waters. (INIS)

24191 (ORNL-EIS-74-21(Supp.2)) ENVIRONMENTAL ASPECTS OF PLUTONIUM AND OTHER ELEMENTS. A Selected, Annotated Bibliography. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. 279p. Dep. NTIS $16.00.

This third published bibliography of 438 references from the computer information file built to provide support to its sponsor, the Nevada Applied Ecology Group of the AEC Nevada Operations Office, emphasizes the early (before 1962) unclassified and declassified literature that concerns plutonium, uranium, and the Nevada Test Site (NTS). Included are environmental aspects of the nuclear devices tested at the NTS, supporting investigations that provide background information on the Test Site, such as basic studies of the flora, fauna, and geology of that area, and basic biological and medical studies on the effects of plutonium and uranium, particularly as they relate to health considerations for man. Every reference provides an abstract. Abstracts are findings-oriented. Additional numerical data is included in a special field or referred to in the comment field. Indexes are given for author, subject category, keywords, geographic location, permuted title, taxons, and publication description. (auth)

24192 (SCPRI(RM)-8-1973) MONTHLY PROGRESS REPORT. (Service Central de Protection contre les Rayonnements Ionisants, 78-Le Vesinet (France)). Aug 1973. 13p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

Data are reported on the radioactivity in environmental samples. Data are presented on radioactivity in atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chains (milk, plants, cattle, fish), sea water around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables (^{7}Be, ^{95}Zr and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba and ^{140}La, ^{90}Sr, ^{106}Ru and ^{106}Rh, ^{226}Ra, ^{54}Mn, U, and T). A monthly bibliographic selection is also presented. (FR)

24193 (SCPRI(RM)-8-1973(App.)) APPENDIX TO THE MONTHLY PROGRESS REPORT: DETAILS OF THE RESULTS OF MEASUREMENTS. (Service Central de Protection contre les Rayonnements Ionisants, 78-Le Vesinet (France)). Aug 1973. 20p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

Data are tabulated on the radioactivity found in environmental samples collected from various locations in France during August 1973. (CH)

24194 (SCPRI(RM)-9-1973) MONTHLY PROGRESS REPORT. (Service Central de Protection contre les Rayonnements Ionisants, 78-Le Vesinet (France)). Sep 1973. 15p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

Data are reported on the radioactivity in environmental samples. Data are presented on radioactivity in atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chains (milk, plants, cattle, fish), sea water around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables (^{7}Be, ^{95}Zr and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba and ^{140}La, ^{90}Sr, ^{106}Ru and ^{106}Rh, ^{226}Ra, ^{54}Mn, U, and T). A monthly bibliographic selection is also presented. (FR)

24195 (SCPRI(RM)-9-1973(App.)) APPENDIX TO THE MONTHLY PROGRESS REPORT: DETAILS OF THE RESULTS OF MEASUREMENTS. (Service Central de Protection contre les Rayonnements Ionisants, 78-Le Vesinet (France)). Sep 1973. 24p. (In French). Dep. NTIS (U. S. Sales Only) $3.25.

Data are tabulated on the radioactivity found in environmental samples collected from various locations in France during September 1973. (CH)

Atmosphere

24196 (INIS-mf-887, pp 235-251) MIGRATION OF GLOBAL RADIOISOTOPES IN VARIOUS SPHERES. Makhonko, K. P. [nd]. (In Russian).

The migration of radioisotopes in the atmosphere, the hydrosphere, and the biosphere is briefly discussed. The calculation of the radioisotope transport in air, water, and soil is dealt with in more detail. Equations for the calculation of the ^{90}Sr and ^{137}Cs migration in soils are also presented. (INIS)

24197 (UCRL-74887) CLIMATE STUDIES USING A ZONAL ATMOSPHERIC MODEL. MacCracken, M. C.; Luther, F. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Jan 1974. Contract W-7405-eng-48. 41p. (CONF-740106-2). Dep. NTIS $5.25.

From 1st special assembly of the International Association of Meteorology and Atmospheric Physics; Melbourne, Australia (14 Jan 1974).

The second generation zonal atmospheric model ZAM2 is being developed and applied to studies of the potential climatic impact of stratospheric injection of trace species by high altitude aircraft. The model is a two-dimensional general circulation model using a 5° latitude grid at nine pressure levels extending into the stratosphere. The effect of terms lost by zonal averaging is simulated by introduction of an eddy transport mechanism in which the eddy diffusion coefficient is a function of internal model variables. ZAM2 strives to model the thermodynamics and hydrology of a moist atmosphere under the influence of solar and long wave radiation, and includes precipitation, cloudiness, convection and surface interactions. The planetary surface is represented as fractionally divided at each latitude band between open ocean, sea ice, and land which may have mountains of various heights. A surface energy balance is maintained allowing heat storage in the land, the build-up and decay of snow cover, and the growth and melting of sea ice. The model uses a fifteen minute time step and may be run for several years without severe penalties in computation time. Model validation includes comparison with climatic data and other modeling efforts as well as sensitivity studies of various modeled processes. Application of this model to the Climatic Impact Assessment Program involves studying the effects of injection of aerosols, reduction in stratospheric ozone heating, and possible perturbations resulting from water vapor injection. (auth)

24198 CONTROLLING EMPLOYEE EXPOSURE TO ALPHA RADIATION IN UNDERGROUND URANIUM MINES. Volume 2. Appendixes for the Use of Radon-Daughter Control Specialists. Rock, R. L.; Dalzell, R. W.; Harris, E. J. Washington, DC; Bureau of Mines (1971). 183p. GPO $1.00.

This guide was prepared for the use of uranium mine ventilation engineers and radon-daughter control specialists. Topics discussed include: methods for mine ventilation surveys; radon-daughter sampling instruments and their calibration; sampling patterns and potential sampling errors; personal radon-daughter recording devices; and the maintenance of individual records of radon-daughter exposure for employees. (CH)

Soil

Refer also to abstracts 24183 and 24184.

24199 ENVIRONMENTAL CONTAMINATION BY URANIUM. 3. Effects of Carbonate Ion on Uranium Adsorption to and Desorption From Soil. Yamamoto, T.; Yunoki, E.; Yamakawa, M.; Shimizu, M. (Hygienic Lab. of Okayama Prefecture, Japan). J. Radiat. Res.; 14: No. 3, 219-224(Sep 1973).

Adsorption of uranium on soils and its desorption from uranium-adsorbed soils in the presence of carbonate ion were examined by using three kinds of soils: alluvial soil, sandy soil and volcanic ash soil. The absorption ratio of uranium for each soil was approximately 100% for the mixtures of uranyl (1 to 50 μgU/ml) and carbonate solutions (4.3 to 109 μgCO_3^{2-}/ml). In the uranium adsorbed soil (7.1 to 500 μgU/g air-dried soil) with carbonate ion (4.3, 43.4 μg/ml), the desorption ratio of uranium for each soil was low (0.09 to 1.2%). The adsorption of uranium on soils and the desorption from uranium adsorbed soils with stream water were probably similar to those with carbonate solution. (auth)

24200 RADIOACTIVE CONTAMINATION OF FRUIT TREES BY FISSION PRODUCTS. 2. Distribution of the Replaceable ^{90}Sr in the Soil of a Citrus Orchard. Shiraishi, Y. (National Inst. of Radiological Sciences, Chiba, Japan). J. Radiat. Res.; 14: No. 3, 225-230(Sep 1973).

Since 1961 through 1971, this study was conducted to determine the distribution of the replaceable ^{90}Sr in loam surface soil originated from volcanic ash under three kinds of soil management, i.e. clean, mulch, and sod systems at a citrus orchard. The level of the replaceable ^{90}Sr in the surface soil measured in 1963 was in the order of clean (41) = sod (40) > mulch (31 nCi/m^2 · (0 to 30 cm)) and decreased exponentially with a half-time of approximately 5.9, 12.3, and 10.2 years for clean, mulch, and sod systems, respectively. It was observed that the distribution coefficient of ^{90}Sr calculated for these soils depended largely on the replaceable ^{90}Sr content in surface soil and that the level of the coefficient in the soil under each soil management system in 1971 was nearly equal to that in 1961. The distribution coefficient of three systems are in order of clean < sod < mulch. (auth)

24201 RADIOACTIVE CONTAMINATION OF FRUIT TREES BY FISSION PRODUCTS. 3. Distribution of the Replaceable ^{137}Cs in the Soil of a Citrus Orchard. Shiraishi, Y. (National Inst. of Radiological Sciences, Chiba, Japan). J. Radiat. Res.; 14: No. 3, 231-235(Sep 1973).

Since 1961 through 1971, the replaceable ^{137}Cs content in the same surface soil of the same area under clean, mulch, and sod systems of soil management at a citrus orchard was determined in order to compare its annual change with that of replaceable ^{90}Sr. The relation of humus content in surface soils classified as clean < sod < mulch closely related to half-time for an exponential decrease of replaceable ^{137}Cs from 1963 through 1971 and with distribution coefficient for the downward distribution of replaceable ^{137}Cs in surface soil. Both half-times of approximately 8.5, 45.2, and 30.7 yrs and distribution coefficient of 0.094 to 0.111, 0.142 to 0.165, and 0.129 to 0.140 for clean, mulch, and sod, respectively, are larger than those of ^{90}Sr. The ratios of replaceable ^{137}Cs to ^{90}Sr of 0.92 to 1.13 in surface soil found for the year from 1961 through 1967 followed by a slight increase afterwards and reached 1.24 to 1.36 in 1971. It was found that ^{137}Cs is fixed much more strongly than ^{90}Sr in the surface soil of a citrus orchard. (auth)

Water

24202 (INIS-mf-887, pp 280-293) EFFECT OF HUMAN ACTIVITIES ON ^{226}Ra MIGRATION IN ENVIRONMENT. Wlodek, S. (Centralne Lab. Ochrony Radiologiczrej, Warsaw). [nd]. (In Russian).

The concentration of ^{226}Ra was measured in the water, river bed, and in neighboring plants of a mountain river in the Giant Mountains area in Poland. The investigation was aimed at ascertaining whether or not industrial and building efforts carried out in areas of an increased natural radioactivity resulting, e.g., from former discharge dumps, can affect radiological safety of the population in the area. In the years 1967, 1968, and 1969 an increased concentration of the radionuclide was observed; no risk, however, resulted for the population. The results indicate, nonetheless, that large-scale industrial activities might, under certain circumstances, result in natural radioisotope accumulation representing radiological risks for population. (INIS)

24203 (TID-26518) EXCERPTS FROM SRL MONTHLY REPORTS ON WASTE MANAGEMENT. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Jun 1967. 6p. Dep. NTIS $3.00.

Radiophosphorus was first pumped to the K-Area 50-million gallon containment basin from the vertical tube storage basin at the Savannah River Plant in August 1965. From September to mid-November 1965, Tendipedidae midges emerging from the containment basin had sorbed ^{32}P by factors of 10^5 to 10^6 (^{32}P midge/water ratio), and spread the ^{32}P locally. Attempts to control the midges by applying DDT and pouring diesel oil on the surface of the water did not succeed. Essentially no midges emerged during the winters of 1965-66 and 1966-67; and during the warm months of 1966 their emergence was controlled effectively by two applications of Abate 4E, malathion, and diesel oil. Dragonflies that were collected near the basin during this period accumulated ^{32}P by a factor of $\sim 10^3$. Data are also presented on the content of ^{32}P in algae; fish, beetles, crickets, grasshoppers, and insect-eating birds collected in the area, and in Lespedeza growing on the lateral trenches and banks of the large containment basin. (CH)

24204 (TID-26531) DISTRIBUTION OF RADIONUCLIDES IN THE COLUMBIA RIVER STREAMBED FROM THE NUCLEAR REACTORS, HANFORD RESERVATION TO LONGVIEW, WASHINGTON. Haushild, W. L.; Dempster, G. R. Jr.; Stevens, H. H. Jr. (Geological Survey, Portland, Oreg. (USA). Water Resources Div.). 1973. 78p. Dep. NTIS $5.45.

Until all the eight reactors that were cooled by once-through flow of treated Columbia River water were shut down in 1971, their cooling-water effluents were the main source of dissolved and particulate radionuclides in the Columbia River. The distribution and quantities of radionuclides accumulated in the riverbed were investigated; reconnaissance surveys of radionuclide concentrations and particle size of surficial sediment and sediment at depth were made; radionuclide discharges at two locations were defined; and radionuclide concentrations in surficial sediment at three river locations were observed semimonthly. Data presented on radioisotopes in Columbia River sediments include: seasonal variations; fixation in coarse and fine sediments; stratigraphic distribution; geographic distribution, and total accumulated quantities of ^{60}Co, ^{51}Cr, ^{54}Mn, ^{46}Sc, and ^{65}Zn. (LCL)

Ecosystems and Food Cycles

Refer also to abstracts 24481, 24519, 26492, 26516, and 26517.

24205 BEHAVIOR OF ^{60}Co IN A NON-FLOWING SMALL-SCALE RICE FIELD ECOSYSTEM. Honda, Y. (Kinki Univ., Osaka); Muraoka, T.; Koga, T. J. Radiat. Res.; 14: No. 3, 209-218(Sep 1973).

Radioecological behavior of ^{60}Co after a single administration was investigated in a non-flowing small-scale rice field ecosystem, which consisted of natural pond water, rice seedlings, mud snails, loaches, earthworms and sandy soils. The radioactivity of ^{60}Co in water decreased rapidly for about ten days and gradually thereafter. Ten days after addition of ^{60}Co, the fraction, remained in aqueous phase, was about 0.1% of the initially administered radioactivity. The radioactive concentrations of both mud snails and earthworms reached maximums in two hours, while those of rice seedlings, loaches, and sandy soils reached maximums in one day, and then decreased with time to an equilibrium level. The relative order for maximum concentration factors was: rice seedling > mud snail > sandy soil > earthworm > loach. In a mass balance analysis of the radionuclide in the system, ^{60}Co retained in the biomass including side wall algae grown during the experiment showed about 12%, although the proportion based on wet weight of the biomass was only about 2.3%. (auth)

Radiometric Techniques

Refer also to abstracts 23933 and 24342.

24206 (DEMO-73-4-E) USE OF RADIOISOTOPES IN TRACING KARST GROUNDWATER: IN GREECE. IV. Investigation on the Possible Interconnection between Sinkholes of Milea and Taka Lake With Various Springs of the Near Area. Leontiadis, J.; Dimitroulas, C. (Democritus Nuclear Research Center, Athens (Greece)). Jun 1973. 29p. Dep. NTIS (U. S. Sales Only) $3.50.

Ground water flow in the Karst region of Greece was studied using ^{51}Cr-EDTA as tracer. Investigations were made of any possible interconnection between Milea and Taka lake sinkholes, on the high plateau of Tripolis, with a number of springs of Argos, Achlacampos, Arkadia, Lakonia, Messinia, Ladon River, and the Loussios River area. (auth)

24207 MEASUREMENT ACCURACY IN PULSED NEUTRON LOGGING. Chrusciel, E.; Morstin, K.; Starzec, A. (Miedzyresortowy Instytut Techniki Jadrowej, Krakow). Nukleonika; 18: No. 11, 552-565(1973). (In Polish).

The method of error evaluation in pulsed neutron logging with three-gate detection is presented. The total error of the measured value of the neutron lifetime τ_m is caused by the statistical character of the registered radiation as well as by instrumental factors which include the instabilities of the time-analyzer gates and the dead-time of the registration system. Two cases are discussed: (a) in situ measurements with the scalers; and (b) continuous logging with the rate-meters. In both cases the problem of statistical dependence of signals from different channels of the time-analyzer should be solved if the accuracy of τ_m determination is to be properly estimated. (auth)

24208 PREHISTORIC TIMES MEASURED WITH THE CARBON CLOCK. Nobel Prize-Winner Willard Libby is Celebrating His 65th Birthday. Bruns, K. Welt (Hamburg); No. 294, 16(Dec 1973). (In German).

Willard Libby's method of isotope dating, the radiocarbon method, is briefly discussed in this article that has been written on the occasion of his 65th birthday. (GE)

24209 MEASURING TIME AND ACCURACY OF MEASUREMENT OF THE RADIOCARBON METHOD. Sawelski, F. (Azerbaydzan Geographical Inst., Baku). Ideen Exakten Wissens; No. 8, 539-544(1972). (In German).

As the accuracy of the available measuring techniques has been found to be insufficient for quite a number of scientific problems, attempts have been made to improve the accuracy within the limits set by the nature of the problems to be solved. Measurements according to the radiocarbon method are taken as an example to show that the optimization of both methodic and measuring performance allows the exact determination of certain instability coefficients of a measuring device. (GE)

24210 GAMMA RADIATION MEASUREMENTS OF BULK DENSITY CHANGES IN A SOIL PEDON FOLLOWING IRRIGATION. Reginato, R. J. (Agricultural Research Service, Phoenix, AZ). Soil Sci. Soc. Amer., Proc.; 38: No. 1, 24-29(1974).

Bulk density in a soil pedon was measured with a gamma transmission technique utilizing ^{137}Cs and ^{241}Am. Both gamma-ray sources could not be used simultaneously for bulk density determinations in a system where the sources were uncollimated and the detector was not shielded. By alternating sources for each scan down the soil profile, it was shown that bulk density decreased in the top 6 cm of soil about 30 minutes after water was ponded on the soil surface. As soon as the water drained from the surface, bulk density values approached preirrigation levels. Changes in height of the soil surface upon irrigation corresponded with changes in bulk density. (auth)

24211 ESTIMATING SOIL EROSION FROM THE REDISTRIBUTION OF FALLOUT ^{137}Cs. Ritchie, J. C.; Spraberry, J. A.; McHenry, J. R. (Sedimentation Lab., Oxford, MS). Contract AT(49-7)-3029. Soil Sci. Soc. Amer., Proc.; 38: No. 1, 137-139 (1974).

The movement of fallout ^{137}Cs from soils in three north Mississippi watersheds was found to be logarithmically (r = 0.89) related to potential soil loss. Analysis of published data on ^{137}Cs as well as the north Mississippi data also showed a significant (r = 0.95) logarithmic relation existing between soil loss and ^{137}Cs loss from soils. This study indicates that it may be possible to calculate soil loss from the movement of fallout ^{137}Cs in watersheds. Also it may be possible to calculate the movement of surface adsorbed nutrients like ^{137}Cs in watersheds from soil erosion data. (auth)

24212 BOREHOLE ANALYSIS FOR COPPER AND NICKEL USING GAMMA-RAY RESONANCE SCATTERING. Sowerby, B. D.; Ellis, W. K. (Australian Atomic Energy Commission, Sutherland). Nucl. Instrum. Methods; 115: No. 2, 511-523(1974).

A technique has been developed for the in-situ determination of copper and nickel in boreholes using γ-ray resonance scattering. A radioisotope is chosen so that in the gaseous state its γ rays resonantly scatter via an excited state of the wanted element. This makes the process highly specific to the wanted element. Results are presented for the determination of copper and nickel in 7.5 to 20 cm diameter simulated boreholes using gaseous sources of ^{65}ZnI$_2$ and ^{60}CoBr$_2$, respectively. A probe design suitable for use in boreholes of diameter $\gtrsim$ 14 cm is described. The resonance photopeak count rate with this probe in a 15 cm diameter borehole was 5 counts/s per 5 Ci ^{65}Zn for a sample containing 1 wt.% copper. The background under the photopeak was 5 counts/s while the count rate at lower energies due to Compton scattered radiation was about 10 k counts/s. The estimated counting time for the determination of 0.5 wt.% copper to ±0.1 wt.% in boreholes is about 50 s which permits logging speeds of about 0.6 m/min for examination of a 0.5 m strata width. Similar results have been obtained for nickel. Variations in factors such as rock density, borehole diameter and probe location will affect the probe count rates but in most field situations the combined errors from these sources should not exceed ±20% of the elemental concentration. Compared to the various other nuclear methods of analysis the γ-ray resonance technique is shown to have many advantages for the analysis of copper and nickel, particularly copper. The use of a resonance probe in a 15 cm diameter borehole drilled by one of the coreless drilling techniques will offer the following advantages over diamond-core drilling: (1) drilling costs are reduced by at least half, (2) a prompt measure of elemental concentration is obtained; cores generally take at least a week for transport and analysis, (3) the rock sampled by a resonance probe is ≈ 20 times the 2–3 kg/m sampled by diamond drilled cores. (auth)

Site Surveys

Refer also to abstracts 24187, 26343, 26344, 26347–26349, 26353, and 26355.

24213 (ARH-SA-169) SOIL MOISTURE TRANSPORT IN ARID SITE VADOSE ZONES. Isaacson, R. E.; Brownell, L. E.; Nelson, R. W.; Roetman, E. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jan 1974. Contract AT(45-2)-2130. 25p. (SM-182-6; CONF-740312-1). Dep. NTIS $4.00.

From symposium on isotope techniques in groundwater hydrology; Vienna, Austria (11 Mar 1974).

Soil moisture transport processes in the arid soils of the United States Atomic Energy Commission's Hanford site are being evaluated. The depth of penetration of meteoric precipitation was determined by profiling fallout tritium at two locations where the water table is about 90 m below ground surface. In situ temperatures and water potentials were measured with temperature transducers and thermocouple psychrometers at the same location to obtain thermodynamic data for identifying the factors influencing soil-moisture transport. Neutron probes are being used to monitor soil moisture changes in two lysimeters, three meters in dia by 20 m deep. The lysimeters are also equipped to measure pressure, temperature, and relative humidity as a function of depth and time. Theoretical models based on conservation of momentum expressions are being developed to analyze nonisothermal soil moisture transport processes. Future work will be concerned with coupling the theoretical and experimental work and determining the amount of rainfall required to cause migration of soil-moisture to the water table. (auth)

24214 (DPST-71-332) MINERALOGY AND ION EXCHANGE CHARACTERISTICS OF SAVANNAH RIVER PLANT STREAMBED SEDIMENTS. Hawkins, R. H. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). May 1971. Contract AT(07-2)-1. 16p. Dep. NTIS $3.00.

Samples were collected of bottom sediments from three SRP streams and of soils from the source areas of the sediments. The samples were analyzed for clay and organic matter contents, cation exchange capacity (CEC), and mineralogy of the sand, silt, and clay fractions. Results of these analyses and intrepretation of the data lead to the following conclusions: quartz is the dominant mineral in the sand and silt fractions; kaolinite is the dominant mineral in the clay fractions; no illite, chlorite, vermiculite, or montmorillonite minerals are present; the average clay content of the sediments is 32% by weight; the average organic matter content of the sediments is 1.26% by weight; the average CEC of the sediments is 2.61 meq per 100 g; and the highest sorptive capacity is in the downstream sediments near and in the Savannah River swamp. (auth)

24215 ECOLOGICAL EFFECTS OF INTERTIDAL UPLIFTING FROM NUCLEAR TESTING. Lebednik, P. A. (Univ. of Washington, Seattle). Mar. Biol.; 20: No. 3, 197-207(Jun 1973).

Uplifting of a portion of an intertidal rock bench by the "Milrow" underground nuclear test at Amchitka Island, Alaska affected algal abundance, species composition, and zonation. Parts of the populations of 8 species died off, primarily in the Hedophyllum sessile zone, and mostly within the first 6 months after the disturbance. The center of abundance of these species shifted seaward. Fucus distichus, a species of the upper intertidal, appeared in the area and recolonized a portion of the H. sessile zone. The observations indicate that intertidal algal communities at Amchitka Island are very sensitive to positive elevation changes. (auth)

24216 NUCLEAR SYSTEMS: ENVIRONMENTAL CONSIDERATIONS SESSION SUMMARY. Basham, S. J. Jr. (Battelle Columbus Labs., OH). J. Environ. Sci.; 16: No. 5, 17-21(1973).

The topic of environmental considerations of nuclear systems is one of great current interest to those in the utility industry with nuclear power plants and to the public, in general. The current level of technology in this area was explored in a number of papers at a session of the 1973 Institute of Environmental Sciences' Annual Meeting. This session summary was prepared to aid in reaching a wider audience than the attendees at the session. (auth)

24217 ENVIRONMENTAL IMPACT STATEMENTS FOR NUCLEAR POWER PLANTS. Kathren, R. L. (Portland General Electric Co., OR). J. Environ. Sci.; 16: No. 5, 11-16(1973).

Environmental impact statements for nuclear power plants are discussed in terms of: history and legal development following the enactment of the National Environmental Policy Act of 1969; the preparation of environmental statements and what happens to such statements following preparation; and how to evaluate whether environmental statements are effective. (LCL)

Thermal Effluents

Refer also to abstracts 24230, 24519, 25962, 26087, 26183, 26191, 26194, 26334, 26343, and 26344.

24218 (CONF-740211-1) TVA PILOT GREENHOUSE FOR WASTE HEAT RESEARCH. King, L. D.; Furlong, W. K. (Tennessee Valley Authority, Muscle Shoals, Ala. (USA); Oak Ridge National Lab., Tenn. (USA)). 1973. 21p. Dep. NTIS $3.25.

From American Society of Agricultural Engineers meeting; Memphis, Tennessee, USA (4 Feb 1974).

A pilot facility for evaluating the use of waste heat from power plants, both fossil-fueled and nuclear, to heat a greenhouse was designed and built at the TVA reservation at Muscle Shoals, Ala. The simulation of waste heat was from an electric hot water heater. The subjects to be evaluated included: greenhouse environmental control system operation during one year period under wide range of climatic conditions and the crop performance, i.e., yield and disease control under various controlled-environment conditions and with various rooting media conditions. The facility design, control instrumentation, tests performed, and operating conditions obtained for airflow, air temperature, and humidity are described. No information is included on the crops produced. It is concluded that the pilot facility is providing valuable guidelines for the design of a larger demonstration plant to be located at an operating power plant. (LCL)

24219 (EPA-660-3-73-4) WATER QUALITY REQUIREMENTS OF AQUATIC INSECTS. Gaufin, A. R. (Utah Univ., Salt Lake City (USA)). Sep 1973. Contract 14-12-438. 98p. GPO $1.20.

The larvae of twenty species of aquatic insects (Diptera, Ephemeroptera, Plecoptera, and Trichoptera) and the scud (Amphipoda) were exposed to high water temperatures, low dissolved oxygen concentrations, and low pH to determine their tolerance of these three environmental factors. The temperature at which 50% of the specimens died after 96 hours exposure ranged from 11.7°C for the mayfly, Cinygmula par Eaton, to 32.6°C for the snipe fly, Atherix variegata Walker. The mayfly, Ephemerella doddsi Needham, was most sensitive to low dissolved oxygen levels with a 96-hour TLm of 5.2 mg/l. Acroneuria pacifica Banks, a stonefly, was the most resistant with a ^{96}TLm of 1.6 mg/l. Median tolerance levels for pH ranged from pH 2.7 for the caddis fly, Limnephilus ornatus Banks, to 7.2 for the scud, Gammarus limnaeus Smith. Longer term bioassays clearly indicated increased sensitivity and mortality of the test specimens with increased length of exposure to each of these factors. (auth)

24220 (ORNL-TM-4438) TEMPERATURE SENSITIVE ULTRASONIC FISH TAG, Q-5099. Rochelle, J. M.; Coutant, C. C. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 29p. Dep. NTIS $3.50.

A small electronic transmitter that utilizes interval modulation of ultrasonic pulses was developed for temperature telemetry from free-ranging aquatic animals. The temperature sensor is a thermistor in the tip of a flexible appendage. The entire unit, including the thermistor, can be completely implanted in the animal's body, or the flexible appendage can be left outside the body cavity to enable internal or external temperature measurement, respectively. The received signal is decoded using commercially available gear by interfacing the output of an ultrasonic receiver with a digital time intervalometer. The data can be stored on punched paper tape for later conversion to temperature by a computer. The usable range of the transmitter extends to 500 m, and its calibration accuracy is within ±0.2°C over a range from 5 to 35°C. This calibration is maintained throughout the life of the battery. The air weight varies from 16.2 g for a transmitter with a life of 6 weeks to 37.0 g for one with a life of 60 weeks. Use of a breadboard integrated circuit enables production of a small number of units at a reasonable unit cost. (auth)

24221 WASTE HEAT DISPOSAL IN LARGE STEAM POWER STATIONS. Oplatka, G. Brown Boveri Rev.; 60: No. 7/8, 315-320(1973).

It is a natural law that in converting thermal energy into mechanical (electrical) energy, heat must be discharged to the environment. In the case of large steam power stations this can involve problems concerning environmental protection. These problems are discussed, the traditional solutions to them are reviewed, impetus is given to further investigation of the engineering aspects and their impact of the environment. (auth)

24222 ADVANCES IN WATER POLLUTION RESEARCH. Proceedings of the Sixth International Conference Held in Jerusalem, Israel, June 18-23, 1972. Jenkins, S. H. (ed.). Elmsford, NY; Pergamon Press, Inc. (1973). 970p. (CONF-720618-). $45.00.

Seventy-two papers were presented. A separate abstract was prepared for each of three papers. The remaining 69 papers covered various aspects of water pollution not within the scope of NSA. (LCL)

For abstracts of individual papers see: 24223, 24224, and 24819.

24223 STREAM TEMPERATURE RESPONSE TO THERMAL POLLUTION. Novotny, V.; Krenkel, P. A. (Vanderbilt Univ., Nashville). pp 1-10 of Advances and Water Pollution Research. Jenkins, S. H. (ed.). Elmsford, NY; Pergamon Press, Inc. (1973).

From 6th international conference on water pollution research; Jerusalem, Israel (18 Jun 1972). See CONF-720618-.

Before the thermal pollution effects of discharging into surface waters, particularly rivers, waste heat from future U.S. conventional and nuclear power plants can be evaluated, it is necessary to consider the river assimilative capacity for heat, the thermal behavior of water in rivers, and the response in water temperature that can be expected from added waste heat with respect to certain meteorological conditions. Therefore, a mathematical model describing temperature changes in rivers was developed which takes the difference between stream flow and lakes and reservoirs into account. The results of this investigation lead to the following conclusions: since the surface renewal coefficient for the water boundary layer is several orders of magnitude greater than the exchange coefficients in the air boundary layer, the turbulence intensity in the water surface layer or in the water body has very little influence on the heat exchange rate between the water and the air, and in most cases, the heat exchange between air and flowing water is governed by the heat, vapor, and radiation exchange rate in the air boundary layer; the heat (vapor) exchange coefficient in the air boundary layer is to some extent dependent on a characteristic length of the boundary layer formation; the value of the heat (vapor) exchange coefficient in the air boundary layer is dependent on the vectoral subtraction of the wind and water surface velocities; and the initial thermal load to the stream, $\Delta T_i = T_i - T_n$, may be assumed to be constant during a certain time period. This assumption leads to the division of the equation of heat transfer in streams into two simultaneous equations, one describing the natural temperature and the other depicting the steady decay of the thermal load. If the behavior of the natural temperature is known, the entire computation is significantly simplified, even when the thermal load to the stream is not at a steady state condition. It is significant to note that costly and sometimes inaccurate measurements of cloud cover, solar radiation, and humidity are not necessary inasmuch as the overall heat exchange coefficient, K, is dependent only on wind velocity, stream surface velocity, air temperature and, to a lesser extent, on the area of the water surface. (LCL)

24224 PREDICTIONS OF TEMPERATURE IN STREAMS RECEIVING THERMAL DISCHARGES BY USING A DETERMINISTIC MODEL AND COMPUTER TECHNIQUE. Berger, F. (Biologische Station Lunz, Austria); Schmitz, W. pp 11-22 of Advances and Water Pollution Research. Jenkins, S. H. (ed.). Elmsford, NY; Pergamon Press, Inc. (1973).

From 6th international conference on water pollution research; Jerusalem, Israel (18 Jun 1972). See CONF-720618-.

The assumptions used for developing a deterministic model of the thermal situation in streams which receive thermal discharges are given, and the procedures for and results of numerical calculations using the model are described. This model was used to predict temperature changes expected to occur in the Rhine River between the mouth of the tributary Aare and the city of Basel after the installation of future power plants. (LCL)

Chemical Effluents

Refer also to abstracts 23896, 23952, 23953, 23957, 24222, 24364, 24405, 26194, 26334, 26343, 26344, and 26521.

24225 (BNWL-SA-4684) ADVANCES IN THE THEORY AND MODELLING OF POLLUTANT-GAS WASHOUT. Hales, J. M.; Dana, M. T.; Wolf, M. A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Apr 1973. Contract AT(45-1)-1830. 7p. (CONF-731057-1). Dep. NTIS $3.00.

From third international clean air congress meeting; Dusseldorf, F. R. Germany (8 Oct 1973).

A program for evaluation of precipitation scavenging as a mechanism of removal of contaminants from power plant plumes has been in progress. This program began with field studies at the Keystone plant in Western Pennsylvania, which led to the development of new gas-washout models and related field studies at other locations. The progress of this program is described and some comparisons of measured SO_2 washout concentrations with those predicted by reversible and irreversible gas washout models are presented. Recommendations for application of the gas-washout models for environmental impact analysis are made. (auth)

24226 (EPA-600-5-73-8-a) STATE-OF-ART REVIEW: WATER POLLUTION CONTROL BENEFITS AND COSTS. Volume I. Unger, S. G.; Emerson, M. J.; Jordening, D. L. (Development Planning and Research Associates, Manhattan, Kans. (USA)). Oct 1973. Contract 68-01-0744. 130p. GPO $1.35.

A survey and assessment are presented of the state-of-art of economic analyses dealing with water pollution control benefits and costs. The investigation includes the extension of traditional benefit cost analysis into the area of pollution control. Implications for planning and research plus some directions of needed study are also developed. A conceptual basis for benefit cost analysis involving water quality management is suggested. An economic concept of a social welfare function is presented as the most widely accepted public criterion which embodies environmental quality concerns. Problems of efficiency, equity, externalities and social discount rates are summarized. Water pollution control costs are a function of a host of factors including water quality criteria, specific pollutants, treatment strategy and design capacity. These and other factors are described. The types of available cost estimates—both fixed point and functional, are outlined. Also, the adequacy of such information is assessed. Benefit measurements of water quality factors are meager and underdeveloped. A variety of partial-equilibrium approaches to benefit measurement are outlined and some problems, including the planning horizon (time profile), are described. To assess benefit cost impacts of water pollution control, location-preserved analyses are necessary. An aggregation framework which accounts for spatial interdependencies is needed, and an assessment approach is also proposed. General systems analysis approaches are implicitly required to measure benefits and costs of pollution control. Recent developments in the literature have begun to directly assess impacts of environmental quality management. In this setting, benefit cost analysis effectively becomes a supplementary analysis of alternative sets of simulated general equilibrium types of economic solutions. (auth)

24227 (EPA-600-5-73-8-b) RESEARCH NEEDS AND PRIORITIES: WATER POLLUTION CONTROL BENEFITS AND COSTS. Volume II. Jordening, D. L.; Allwood, J. K. (Development Planning and Research Associates, Manhattan, Kans. (USA)). Oct 1973. Contract 68-01-0744. 218p. GPO $2.10.

Research needs and priorities involving water pollution control costs and benefits are specified. A series of theoretical and methodological research needs are presented. Water quality management is required in a dynamic setting and over a broad range of hydrologic and economic conditions. The common property resource aspects of the problem with the prevalence of externalities complicate the issues involved. These and other factors embedded in the research needs are discussed. A major development of a cost-minimization methodological approach for water quality management is also presented. Within this framework the indicated research needs are more readily identified and explained. An important distinction is made between the economic costs of pollution and the costs of pollution abatement. The economic costs of pollution such as damages, efficiency reductions, increased production expenses, process changes and opportunity costs are a function of water quality, whereas pollution abatement costs are typically a function of the degree of pollution control. For comparable cost comparisons, a transformation of pollution abatement costs in terms of water quality is desired. This transformation need and problem are discussed in detail. Finally, in a series of technical appendices, the following subjects are discussed: water pollution control cost and benefit estimates; water quality associated health impacts; specific pollutant sources, damages and potential treatment methods; and critical levels and damage thresholds for selected pollutants. (auth)

24228 (PB-222509-2) CONCEPTUAL DESIGN AND COST STUDY. Sulfur Oxide Removal from Power Plant Stack Gas. Magnesia Scrubbing, Regeneration: Production of Concentrated Sulfuric Acid. McGlamery, G. G.; Torstrick, R. L.; Simpson, J. P.; Phillips, J. F. Jr. (Tennessee Valley Authority, Muscle Shoals, Ala. (USA)). May 1973. 389p. NTIS $8.00.

A conceptual design and cost study on magnesia scrubbing-regeneration is reported. It describes the process history, current development status, and variations that were pursued, and presents process chemistry, kinetics, and mass transfer data. It outlines the four leading processing techniques for evaluation, and discusses the advantages and weaknesses of magnesia scrubbing-regeneration as compared to other SO_2 removal processes. It gives results of a complete economic evaluation, including details of the capital, annual operating, and lifetime operating cost estimates. It compares magnesia processes with both low (rural) and high (metropolitan) cost limestone scrubbing systems, and gives sensitivities of such variables as unit size, status (new or existing), fuel type, sulfur content of fuel, on-stream time, and net sales avenue. (GRA)

24229 EMISSION REQUIREMENTS FOR GAS TURBINES. Dibelius, N. R.; Ketterer, R. J. Gas Turbine Int.; 14: No. 6, 26-31 (1973).

From ASME winter annual meeting; Detroit, MI (11 Nov 1973).

The emission regulations that apply to gas turbine power plants are tabulated for each state. Tabulated data include effective date of the regulations, whether there is clear coverage of stationary plants, maximum permissible visible emissions, particulate range, SO_2 tolerance, sulfur in fuel, and NO_x tolerance. (SFL)

24230 ENVIRONMENTAL MONITORING HELPS RESOLVE POLLUTION PROBLEMS. Paulus, J. J. (Westinghouse Electric Corp., Raleigh, NC). Westinghouse Eng.; 33: No. 5, 150-155 (Sep 1973).

An environmental monitoring system was developed to help electric industries, industrial plants, and public agencies resolve their pollution problems. The system is made up of environmental sensors, sensor calibration and support equipment, enclosures and towers, and two parallel data acquisition systems. In the Report and Historical System, sensor data is continuously recorded on tape cartridges, which are periodically gathered and their data translated into computer language on cards or tape. Computer processing of the data provides an accurate record of pollutant emissions correlated with time and weather. Operating either independently or in parallel with the recorders is an Operational Real-Time System, which enables an on-site or remote reading station to acquire sensor data on command. An automatic alarm system is available to present data immediately if sensor readings exceed predetermined values. Environmental, air quality, meteorological, and water quality sensors are described. (auth)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 24212, 24838, 24854, 25622, 25893, 25964, 26004, 26142, 26147, 26150, 26246, and 26259.

24231 (ANL-8060(Pt. 1), pp 74-85) ELECTRON ENERGY-LOSS SPECTROMETER: PROGRESS REPORT. Huebner, R. H.; Spence, D.; Steingraber, O. J. 1973.

In radiological and environmental research division annual report: radiation physics, July 1972–June 1973.

Construction of a new apparatus for studying electron scattering processes in gases has been completed. Technical details concerning the design and construction of components of the electron energy-loss spectrometer are presented. (auth)

24232 (CEA-CONF-2436) PHYSICAL LIMITATIONS OF VISUALIZATION DEVICES IN NUCLEAR MEDICINE. Allemand, R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 7 Jun 1973. 15p. (In French). (CONF-730473-1). Dep. NTIS (U. S. Sales Only) $3.00.

From meeting of biomedical electronics; Grenoble, France (13 Apr 1973).

The characteristics of a gamma camera for the visualization of organs are given. The physical limitations of the entry optics and the physical limits of the image converter are discussed in detail. The physical limits are determined by the spatial resolution, detection efficiency, energy resolution, and dead time. Each of these is considered. (JSR)

24233 (CEA-CONF-2437) APPLICATION OF SEMICONDUCTOR DETECTORS IN NUCLEAR MEDICINE, IN VIVO X FLUORESCENCE. Allemand, R.; Benabib, A.; Hellouin, Y.; Laval, M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 14 May 1973. 15p. (In French). (CONF-730557-4). Dep. NTIS (U. S. Sales Only) $3.00.

From meeting for studies of gamma spectrometry; Grenoble, France (7 May 1973).

The x-ray fluorescence method in which nuclear radiation excites a characteristic x ray of the stable tracer is discussed with respect to its role in nuclear medicine. The apparatus used is described in detail. In vivo animal experiments on the utility of this method are discussed. (JSR)

24234 (CEA-CONF-2495) AUTOMATIC CONTROL OF RADIOACTIVE CONTENTS IN EFFLUENTS OF SACLAY. Richard, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 4 Oct 1973. 9p. (In French). (CONF-731213-3). Dep. NTIS (U. S. Sales Only) $3.00.

From first international symposium on CAMAC and on-line computers; Luxembourg, (4 Dec 1973).

This system ensures measuring and recording of radioactive materials on a filter by evaporation of samples of Saclay's effluents. Ten identical measuring stations, RAME-10, are connected to an INTERTECHNIQUE MULTI-20 minicomputer via one CAMAC crate with a dedicated crate controller. Alpha, beta, beta background activities, count time, water sample volumes, and rejected water volumes are transmitted to the computer by several 4 × 16 bits scalers and 2 × 24 bits parallel input CAMAC modules. The computer treates the alarms if any and edits the daily and monthly average calculated results. (auth)

24235 (EGG-565-119(Rev.)) PURIFICATION, GROWTH, AND CHARACTERIZATION OF ALPHA MERCURIC–IODIDE CRYSTALS FOR GAMMA-RAY DETECTION. Schieber, M.; Carlston, R.; Lamonds, H.; Llacer, J.; Randtke, P.; Schnepple, W. (EG and G, Inc., Santa Barbara, Calif. (USA)). Jan 1974. 17p. (CONF-740310-1). Dep. NTIS $3.00.

From international conference on crystal growth-4; Tokyo, Japan (24 Mar 1974).

A comparative study of the purification of α-HgI_2 by zone refining, solvent extraction, and the more effective repeated sublimation method is reported. Detector quality crystals have been grown using initial purified raw materials by either a statical or dynamic pulling vapor-growth or solution-growth method. The latter involves solvent evaporation or slow cooling of saturated solutions in CH_3I, CH_3OH, and CH_2I_2 or by decomplexing solutions containing HgI_3^- for which phase diagrams have been established. X-ray topographical studies indicate that purity rather than perfection is the primary requirement for a detector crystal. The gamma-ray spectrum of ^{241}Am detected at room temperature with statical and dynamically pulled vapor- and solution-grown HgI_2 crystals is also reported. (auth)

24236 (FRNC-TH-420) LOCALIZING PROPORTIONAL COUNTER. Gabriel, A. (Grenoble-1 Univ., 38 (France)). 1973. 82p. (In French). Dep. NTIS (U. S. Sales Only) $6.25.

Thesis.

A simple and extremely versatile system for spatially localizing particles was developed, which could in many cases replace heavier and more costly systems. It is particularly useful for x-rays where it permits kinetic experiments to be performed for the first time, such experiments not being possible with films. The detector is in the form of a filament having a high resistance and a small diameter (8 kΩ, 25 μm) positioned between two planes at negative potentials. The high resistance of the filament and the capacity it forms with the cathode constitutes an RC network. Spatial information is obtained by comparing the rise times of the pulses recorded at each end of the high resistance filament. These pulses are processed by two symmetrical analyzing channels comprised of circuits providing bipolar pulses, the information sought being contained at the moment when the pulse passes through zero. The pulses are then temporally compared using an amplitude time converter delivering pulses whose amplitudes are proportional to the deviations from zero of the pulses. A signal is thus obtained whose amplitude contains the abscissa of the ionizing event. This proportional counter enables the energy loss experienced by the ionized particles to be measured with an accuracy of between 15 and 20%. The spatial resolutions obtained were: 0.2 mm for 60 mm long counters and 0.5 mm for 500 mm long counters. (FR)

24237 (LA-5487-T) DEVELOPMENT OF THE OSO-6 HIGH-ENERGY NEUTRON DETECTOR AND CORRELATION OF MEASURED SOLAR NEUTRON FLUXES TO SOLAR FLARES. Young, F. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 173p. Dep. NTIS $7.60.

Thesis.

The development of a directional high energy (20 to 160 MeV) neutron detector which was flown to satellite altitudes (500 km; circular equatorial orbit) in the NASA Orbiting Solar Observatory (OSO-6) in August 1969 is described. Both the angle of incidence and the energy of the neutron are determined by a proton-recoil telescope (Pilot B scintillation plastic) which provides the source for proton-recoils and defines the dE/dX versus E method for particle identification and energy determination. The telescope is embedded in a scintillation plastic guard counter envelope which eliminates the unwanted charged particle background as well as recoil protons (electrons) whose energies and direction do not satisfy neutron (gamma-ray) detection requirements, respectively. Results from a Monte Carlo calculation indicate that the overall average efficiency within an average angular acceptance of about 29° (FWHM) is approximately $(2.25 \pm 0.113) \times 10^{-4}$. The inflight calibration procedure, the main frame data bit error analysis, and the method for determining the orientation of the detector axis in the spacecraft spin plane are described. Results indicate a discrepancy in the measured $(0.461 \times 10^{-2} \pm 0.254 \times 10^{-2}$ n/cm^{2}sec) and theoretical (2 to 70 n/cm^{2}sec) neutron fluxes which suggests a lack of basic understanding of mechanisms leading to high energy neutron production at the sun. (auth)

24238 (UCID-16434) TIME RESOLVED DETECTION WITH MOS RADIATION DETECTORS WITH MEMORY. Balch, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Jul 1973. Contract W-7405-eng-48. 12p. Dep. NTIS $3.00.

MOS radiation detectors with memory have been used to time resolve a portion of an electron beam pulse from a 704 Febetron. These detectors have the three functions of detection, memory, and readout all integrated into a single device so that time resolved detection can be performed without the requirement of realtime diagnostics. Good agreement was obtained between the waveshapes of the time resolved signal of the MOS radiation detector with memory and a real time MOS radiation detector used as a reference monitor of the Febetron's pulse. The time resolution of the detector system was 6.6 nsec. No effort was made to calibrate the output of the MOS detectors with radiation dose. (auth)

24239 INTEGRATED dE-E DETECTOR SYSTEM MADE BY ION IMPLANTATION. Kostka, A. (AEG-Telefunken, Heilbronn, West Germany); Kalbitzer, S. Appl. Phys. Lett. 23: No. 12, 704-705 (15 Dec 1973).

Boron and phosphorus ions of 8-MeV and 6-keV energy, respectively, have been implanted into silicon single crystals to form a

n^+–n–p^+–n–n^+ structure. Tests of this duodiode nuclear detector system with 5.5-MeV α particles yielded resolutions of about 100 keV (FWHM). (auth)

24240 OFF-LINE USE OF A COMPUTER WITH A GAMMA CAMERA. O'Reilly, R. J.; Collins, P. J.; Ronai, P. M. (Inst. of Medical and Veterinary Science, Adelaide). Australas. Bull. Med. Phys. Biophys.; No. 60, 27-34(1 Dec 1973).

The off-line use of a large computer in the analysis of cerebral radioangiograms is described. It is argued that job "turn around time" is comparable with the on-line use of a small computer. (AT)

24241 PRECISION ETCHING AND THE REPRODUCTION OF FULL-TONE PHOTOGRAPHS USING THE ETCH-TRACKS FROM FISSION FRAGMENTS AND ALPHA RAYS. Thackray, M.; Roman, D.; Hetherington, E. L. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Int. J. Appl. Radiat. Isotop.; 25: No. 2, 49-54(Feb 1974).

The emission of densely ionizing radiation, such as fission fragments or alpha particles, from photographic images toned with radioisotopes (for example ^{252}Cf) permits reproduction of the photograph in the form of a radiation damage pattern in most surfaces with which the photograph is placed in close contact. In many materials, subsequent etching of this damage pattern may cause the photograph to be reproduced in the form of a series of visible etch pits. These etch pits bear a close positional relationship to silver grains in the original photograph and permit its reproduction with high fidelity on many surfaces which are not normally photo-receptive. Since ink transfer from the etched areas to paper etc. is possible, the process may find application in the printing industry as well as in the production of useful and decorative etchings. (auth)

24242 DESIGN OF AN X-RAY TELESCOPE SYSTEM FOR AN ORBITING ASTRONOMICAL OBSERVATORY. Bowles, J. A. (University Coll. of Science and Tech., London); Patrick, T. J.; Sheather, P. H.; Eiband, A. M. J. Phys., E (London); 7: 183-191 (Mar 1974).

The design and construction is described of a package of x-ray telescopes launched in the NASA satellite Copernicus (OAO-3), which began stellar observations in September 1972. It contains three grazing incidence reflectors covering a range of wavelengths from 0.3 to 8 nm, and having a combined collecting area of 40.9 cm^2, with angular resolutions up to 1 minute of arc. This is believed to be the first satellite application of such reflectors in stellar x-ray astronomy. A collimated detector of wavelengths 0.1 to 0.3 nm has a 17.8 cm^2 collecting area. A visible light star tracker detects package misalignment if this should occur. (auth)

24243 DETECTOR FOR THE REGISTRATION OF ULTRACOLD NEUTRONS UNDER CONDITIONS OF INTENSE $\beta-\gamma$ BACKGROUND. Anikolenko, V. A.; Antonov, A. V.; Isakov, A. I.; Perekrestenko, A. D.; Tikhomirov, A. A. Kratk. Soobshch. Fiz.; No. 9, 13-18(Sep 1973). (In Russian).

The construction and electronic circuit of a ^{3}He counter for ultracold neutrons is examined. The counter consists of two semiconductor Au–Si detectors. A special electronic circuit and the semiconductor detectors make it possible to register ultracold neutrons in the presence of high $\beta-\gamma$ background (activity of the trap of the order of a hundred μC). (tr-auth)

24244 RESIN COLUMN NEUTRON MONITORS (4 JAN 1962) (ENGINEERING MATERIALS). (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). (CAPE-2391).

1 drawing.

A counting circuit for Bf3 counters for monitoring resin columns is presented. (WHK)

24245 COMPACT ELECTRONIC SYSTEM FOR AN IMPROVED ALPHA AIR MONITOR (ENGINEERING MATERIALS). (Oak Ridge National Lab., Tenn. (USA)). (CAPE-2387).

4 drawings.

An inexpensive, compact electronic system for use with a recently designed continuous alpha air monitor is presented. The circuit produces three analog outputs, one of which is the ratio of the pulse rates from two alpha detectors while the others provide signals proportional to the pulse rates produced by the individual detectors. All three outputs can be used with strip-chart recorders. To decrease the total number of components, dual integrated circuits were used; one half for each input. Although designed for use with scintillation alpha counters, the system can be used with other types of detectors because integrating (charge sensitive) preamplifiers are used. The linearity and accuracy of the circuit make it suitable for other monitoring applications as well. (auth)

24246 RADIATION CAMERA MOTION CORRECTION SYSTEM. Hoffer, P. B. (to United States Atomic Energy Commission). US Patent 3,780,290. 18 Dec 1973. Filed Date 28 Mar 1972. 8p.

The device determines the ratio of the intensity of radiation received by a radiation camera from two separate portions of the object. A correction signal is developed to maintain this ratio at a substantially constant value and this correction signal is combined with the camera signal to correct for object motion. (Official Gazette)

24247 METHOD OF IMPROVING HIGH-PURITY GERMANIUM RADIATION DETECTORS. Llacer, J.; Kraner, H. W (to United States Atomic Energy Commission). US Patent 3,781,612. 25 Dec 1973. Filed Date 28 Mar 1972. 12p.

A method for improving the response characteristics of high-purity germanium radiation detectors by irradiation, annealing and etching is presented. (Official Gazette)

24248 SELECTION OF THE PARAMETERS OF AN INSTALLATION USING CORONA COUNTERS FOR THE DETERMINATION OF THE TOTAL YIELD OF NEUTRONS FROM ISOTOPIC SOURCES. Vorob'ev, Yu. A.; Ugol'tsev, O. A. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 21, 16-21(1973). (In Russian).

Experiments are described on the selection of the parameters of a detection assembly for the determination of the total yield of neutrons from isotopic sources. The installation consists of moderator cavities for neutron sources and groups of thermal neutron corona counters placed in a circle. During the selection of the parameters of the detection assembly questions on the thermal neutron sensitivity, optimum number of counters, and cavity dimensions are considered. (tr-auth)

24249 EXPERIMENTAL DETERMINATION OF THE SENSITIVITY AND EFFICIENCY OF THERMAL NEUTRON REGISTRATION BY SNM-11 AND SNM-14 COUNTERS. Aksenov, V. A.; Baranskii, S. G.; Semenov, S. N.; Chaikovskii, V. G. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 21, 22-24 (1973). (In Russian).

Experimental data are reported on the sensitivity and efficiency of the thermal neutron registration in oriented and diffuse beams for SNM-11 and SNM-14 boron lined counters operating in the corona regime. (tr-auth)

24250 EFFICIENCY OF REGISTRATION OF THERMAL NEUTRONS WITH THE SNM-17 AND SNM-18 COUNTERS. Baikalov, S. N.; Korolev, V. S.; Korolev, V. I. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 21, 12-15(1973). (In Russian).

The results of the measurement of the efficiency of thermal neutron registration by the SNM-17 and SNM-18 helium-3 counters in a diffuse and oriented beam are reported. The measurement method is discussed. The results of the measurement of the efficiency and sensitivity are given for five exemplary counters of each type. (tr-auth)

24251 EXPERIMENTAL DETERMINATION OF THE PHOTOEFFICIENCY OF SPECTROMETERS WITH Ge(Li) DETECTORS. Akalaev, G. G.; Samoilov, P. S. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 21, 46-51(1973). (In Russian).

Experimental data on the determination of the efficiency of γ ray registration with semiconductor detectors are reported. It is shown that the sensitive area of the detector does not exactly correspond with the magnitude of the photosensitivity of the detector. The size of ϵ_s determined experimentally agrees very precisely with the size of the photoefficiency. (tr-auth)

24252 CONDITIONS FOR THE OPTIMUM SUBSTRACTION OF THE BACKGROUND DURING USE OF COMPENSATION DETECTORS. Gorn, L. S.; Iovlev, M. V. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 21, 97-103(1973). (In Russian).

The optimum conditions are determined for carrying out compensation radiometric measurements, guaranteeing a minimum statistical error of the measurement at a given function of the distribution density of useful and background signals and at a given ratio of their frequencies. Expressions are obtained for the reduction coefficients of the pulse frequency in the selection zone of the optimum pulse filter for the proportional counter. Filter calculations are made for specific distributions of the useful and background signals. (tr-auth)

24253 MEASUREMENT OF THE SENSITIVITY OF GAMMA RAY IMAGING SYSTEMS. Causer, D. A.; Mallard, J. R. (Univ. of Aberdeen, Scotland). Int. J. Appl. Radiat. Isotop.; 25: No. 3, 119-129(Mar 1974).

The method of image formation of stationary and moving detector devices is analysed. Definitions of sensitivity are derived which apply to both types. These are termed the Unit Area Plane Sensitivity and the Imaged Area Plane Sensitivity and are compared in detail with existing definitions of sensitivity. The analysis also reveals the underlying principle that it is impossible to compare meaningfully the sensitivity of a moving detector device with that of a stationary device without stating either the area to be scanned, or the time available for scanning plus the velocity of the moving system. (auth)

24254 MULTI-FUNCTION AMPLITUDE SELECTION DEVICE FOR SELECTIVE RADIOMETRY. Gorn, L. S.; Druzhinin, V. S.; Iovlev, M. V. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 22, 44-53(1973). (In Russian).

An integrated circuit amplitude selection device, designed for performing different functions in the solution of radiometric problems is described. The block diagram of the device and a description of its important units are given. The basic measurement characteristics of the multi-function device are also discussed. (tr-auth)

24255 PULSE COUNTER WITH REGULATION OF THE REPRESENTATION SCALE OF THE NUMERICAL DATA. Gorn, L. S.; Zakharov, D. S.; Iovlev, V. M.; Klimashov, A. A.; Khazanov, B. I. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 22, 54-59(1973). (In Russian).

The construction of a detector pulse counter with stepped change of the scaling factor from 1 to 1.999 with gradations of 0.1, 0.01, and 0.001 is examined. The circuit of this scaler with numerical indication of the measurement results is given. (tr-auth)

24256 DATA EXTRACTION WITH DECADE COUNTING DEVICE. Zakharov, D. S.; Klimashov, A. A.; Khazanov, B. I. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 22, 60-67 (1973). (In Russian).

One of the most frequently used units in instruments for radiation measurements is the decade pulse counter. Questions on data extraction with integrated circuit decade counters and the representation of these data in numerical form are examined. The drive circuit of the neon numerical indicator and the control circuit using type IV-3 vacuum heated indicator are described. Questions on data extraction in binary-decade code in the perforator controlled device and reading output in the number-printing device using the supplementary pulse method are examined. (tr-auth)

24257 COUNTING DEVICE WITH ANALOG REPRESENTATION OF DATA. Zakharov, D. S.; Klimashov, A. A.; Khazanov, B. I. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 22, 68-76(1973). (In Russian).

The construction of a pulse counter to be used with radiation detection instruments is described. It has universal analog representation of data and some linear subranges and logarithmic subranges. The possibility of switching the cascade regime, permitting a preliminary scaling of the signals, in order to reduce the amount of equipment in the device was examined. The digital-analog converter with quasilogarithmic characteristics is described. (tr-auth)

24258 MEDIUM FREQUENCY METER WITH GAS-DISCHARGE INDICATORS. Zhurina, L. S.; Zakharov, D. S.; Klimashov, A. A; Khazanov, B. I. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 22, 77-80(1973). (In Russian).

One of the most widely used units in instruments for radiation measurement is the medium frequency analog meter. The construction of such a device with integrated microcircuits is described. The circuit of the device containing a control cascade using IN-13 type linear gas-discharge indicators is described. (tr-auth)

24259 ANISOTROPY OF A GAS-FILLED THERMAL NEUTRON DETECTOR. Gorn, L. S.; Zhurina, L. S.; Khazanov, B. I. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 22, 96-99 (1973). (In Russian).

The angular dependence of the sensitivity of gas-filled thermal neutron detectors (corona counter, type SNM-18 He proportional counter, and fission chamber) is examined. The calculated dependencies are compared with experimental data. The change of the anisotropy during parallel connection of several detectors, whose axes are located at angles, is evaluated. The magnitudes of the sensitivity of the detectors to oriented and isotropic neutron flux are compared. (tr-auth)

24260 ECONOMICAL TIMERS WITH BRIDGE ELEMENTS. Borovikov, V. A.; Zemlerub, L. A. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 22, 113-116(1973). (In Russian).

One of the circuit elements used in instrumentation for the measurement of rate of pulse arrival from detectors is a time-lag device (timer). Two timers are described. One operates by a Kipp relay circuit and the other with a delay generator and scaling circuits. The principal circuits and experimental results are reported. (tr-auth)

24261 HIGH-TEMPERATURE ACTIVATION DETECTOR FOR IN CORE REACTOR MEASUREMENTS. Bochin, V. P.; Garapov, E. F.; Lomakin, S. S.; Morozov, A. G.; Panfilov, G. G.; Petrov, V. I.; Romanov, V. S.; Samoilov, P. S. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 20, 3-5(1973). (In Russian).

A method for the manufacture of a high-temperature disperse detector is reported. Some of its parameters are given. The detector is prepared by sintering oxide compounds of a series of elements (Lu, Eu, Mn, In, etc.) with oxides of Al and Si. (tr-auth)

24262 WEIGHTLESS ACTIVATION DETECTORS BASED ON ALUMINUM ALLOYS FOR IN CORE REACTOR MEASUREMENTS. Arabei, B. G.; Garapov, E. F.; Inikhov, A. G.; Lomakin, S. S.; Lunin, G. L.; Panfilov, G. G.; Petrov, V. I.; Popov, S. S.; Samoilov, P. S.; Tikhonova, R. S. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 20, 6-10(1973). (In Russian).

Al-based activation detectors with In, Lu, Au, W, and other elements are described. The detectors are used for the measurement of thermal and epithermal components of the neutron field in reactors. Experimental measurements were made of the self-shielding for a series of detectors. (tr-auth)

24263 LAG TIMES IN PROPORTIONAL COUNTERS. Grodko, R. A.; Ivanov, I. D.; Karmanova, A. P.; Klyukvina, E. F.; Sipyagina, N. K.; Chaikovskii, V. G. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 20, 15-19(1973). (In Russian).

Calculated and experimental data on the determination of the lag time in proportional gas counters are reported. It is shown that for counters with cathode diameters of 100 mm the maximum lag time is 25 μsec. (tr-auth)

24264 FLOW PROPORTIONAL COUNTER WITH LARGE INPUT WINDOW. Bogatova, E. P.; Zalmanzon, Yu. E.; Klyukvina, E. F.; Sidorov, V. V.; Chaikovskii, V. G.; Chutkin, O. A. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 20, 24-27 (1973). (In Russian).

The construction of a flow proportional counter SRP-1 with an area of 3×10^{-2} m^2 for the input window is described. Its parameters are given. It is designed for the registration of x-ray, γ, and β radiation with energy from 10 to 25 keV. The results of the experimental investigation of the counter characteristics are reported. (tr-auth)

24265 SILICON SURFACE-BARRIER SEMICONDUCTOR DETECTOR OF THE MOSAIC TYPE. Nikitin, B. A.; Nikitin, V. I.; Sel'dyakov, Yu. P.; Fedoseeva, O. P. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 20, 42-47(1973). (In Russian).

The development of mosaic detectors used for the registration of heavy charged particles is discussed. The criteria for the selection of the blank introduced in the composition of the mosaic detector are reported. The detectors developed have the following parameters: a sensitive surface area of about 10 cm^2, energy resolution of 130 to 140 keV for α particles emitted by ^{241}Am, and thickness of the sensitive area of 0.8 to 2 mm. (tr-auth)

24266 SCINTILLATION GAMMA DETECTOR WITH REFERENCE LINES. Tsirlin, Yu. A.; Pomerantsev, V. V.; Sokolovskaya, T. I. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 20, 48-49(1973). (In Russian).

The dependence of the amplitude resolution, background, and size of the energy equivalent of the reference α radiation in the γ quantum scale on the dimensions of the NaI(Tl) crystal (diameter of 25×25, 40×40, and 63×63 mm) was examined. (tr-auth)

24267 METHODS FOR THE CONSTRUCTION OF SELECTIVE RADIATION DETECTION APPARATUS (REVIEW). Iovlev, M. V. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 20, 50-70 (1973). (In Russian).

A review is given of the different methods for the construction of selective radiometric instruments. The most typical problems in radiometric measurement are examined. A classification is given of contemporary measurement methods. Possible improvements in these devices are noted. (75 references) (tr-auth)

24268 USE OF ADAPTIVE TECHNIQUES IN RADIATION DETECTION INSTRUMENTS. Zhurina, L. S.; Khazanov, B. I. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 22, 10-25 (1973). (In Russian).

The possibility of an increase in the measurement efficiency of some types of radiometric instruments, particularly instruments designed for the measurement of non-stationary processes with unknown areas of changes in the characteristics, is examined. The basic methods for the use of adaptive techniques for solution of these problems are examined. A review is given of a series of installations with use of adaptation: automatic change of the instrument parameters, change of the time characteristics of the apparatus as a function of the mean frequency of the incident signals, and rearrangement of the structure of the instruments. (tr-auth)

24269 PARAMETRIC SERIES OF AMPLIFIERS FOR CONSTRUCTION OF RADIATION DETECTION APPARATUS. Gorn, L. S.; Tarasov, V. A.; Usha, E. B. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 22, 26-36(1973). (In Russian).

The principles for the determination of the optimum composition of a series of amplifiers guaranteeing the construction of selective radiometric instruments with proportional counters (scintillation, gas-filled, and semiconductor) are examined. The selection of the microcircuit element base of the amplifiers in the parametric series is justified. The electrical circuit of the basic amplifier cascade is given. (tr-auth)

24270 FOURTH GENERATION RADIATION DETECTION INSTRUMENTS. Gorn, L. S.; Khazanov, B. I. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 22, 5-9(1973). (In Russian).

The basic aspects characterizing radiometric apparatus, i.e., unit base, design and construction methods, and operating characteristics, are examined. The work on the construction of fourth generation devices is evaluated. Unresolved problems such as increase of the selectivity of the instruments, increase of the accuracy, increase of the measurement efficiency, and increase of the ease of recording measurements are discussed. (tr-auth)

24271 PROPORTIONAL COUNTER PARAMETERS. Burek, A. J.; Blake, R. L. (Univ. of Chicago). Advan. X-Ray Anal.; 16: 37-52(1973).

From applications of x-ray analysis conference; Denver, Colorado, USA (2 Aug 1972). See CONF-720801-.

A flow proportional counter for ultrasoft x-ray applications has been constructed and used to measure proportional counter parameters in the ultrasoft x-ray region at atmospheric and subatmospheric pressures for counting gases of P-10 and methane. It was found that at atmospheric pressures the parametrization given by Zastawny for describing gas amplification in proportional counters applies and values for the parameters for P-10 and methane were measured. For subatmospheric pressures the Zastawny parameters are inadequate. A new parametrization is required. In addition, the linearity of the detector for x-rays of energies of 15 to 0.5 keV was measured for pressures ranging from 750 to 150 torr and found to be excellent in all pressure regions. (auth)

24272 APPARATUS FOR MEASURING NATURAL ^{14}C ACTIVITIES. Hebert, D.; Froehlich, K.; Andreev, A. (Bergakademie, Freiberg i. B.). Isotopenpraxis; 9: No. 10, 358-361(Oct 1973). (In German).

The construction, mode of operation, and properties of an apparatus for the measurement of natural ^{14}C activities of ground and surface water is described. Measurement is performed in three steps: sampling, synthesis of benzol containing the carbon to be checked, and measurement of ^{14}C activities by means of a liquid scintillation counter. (auth)

24273 HEALTH PHYSICS INSTRUMENTATION IN POLAND. Zarnowiecki, K. Technial Meeting No. 10/19. Basel; Nuclex (1972). 8p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

In Poland a variety of health physics instruments are produced. Several types of survey instruments used in industry, mining, and laboratories for dose and contamination measurements or signalization are described. The most interesting instrument is the differential recombination chamber measuring the rate of the dose equivalent of mixed radiation or any, even unknown type of radiation produced by accelerators or nuclear reactors. (auth)

24274 QUANTITATIVE EFFECTS OF STATIONARY LINEAR IMAGE PROCESSING ON NOISE AND RESOLUTION OF STRUCTURE IN RADIONUCLIDE IMAGES. Metz, C. E.; Beck, R. N. (Univ. of Chicago). J. Nucl. Med.; 15: No. 3, 164-170(Mar 1974).

Processing radionuclide image data in an attempt to improve its diagnostic usefulness inevitably changes both the noise and the resolution of structures in the image. Although at present little conclusive evidence exists to indicate whether or not image processing is beneficial, an understanding of the quantitative effects of various processing techniques on parameters of resolution, noise magnitude, and noise texture seems to provide a useful beginning towards solution of the more difficult problem of understanding the effects of image processing on diagnostic image quality. Quantitative effects of stationary linear image processing procedures, which include all convolutions and filtering operations, can be predicted rather simply. In the present work, expressions for predicting these quantitative effects are developed and are applied to computer-synthesized image data to provide illustrative examples of the effects of typical noise-smoothing and resolution-enhancing operations. (auth)

24275 TRACK DISCRIMINATION OF LOW-ENERGY NUCLEI IN PLASTICS. Baroni, G.; Di Liberto, S.; Petrera, S.; Romano, G.; Sgarbi, C. (Univ., Rome). Nucl. Instrum. Methods; 115: No. 2, 545-552(1974).

The efficiency of nitrocellulose-plastic sheets as external detectors is studied as a function of impinging-particles angle, energy-loss rate and other experimental conditions also in the presence of a high background of neutral and singly-charged particles. The discrimination among low-energy nuclei ($2 \leq Z \leq 6$) with a two-step method of analysis was achieved with the definition of a parameter (w), connected with the measured etched length of the tracks, that ensures their almost certain assignment to the various nuclear species. (auth)

24276 CALCULATED PHOTOPEAK EFFICIENCIES OF NaI CRYSTALS FOR A 4π DETECTING GEOMETRY. Rieppo, R. (Univ. of Oulu, Finland). Nucl. Instrum. Methods; 115: No. 2, 541-543(1974).

Photopeak efficiency values were calculated for NaI-crystals forming a 4π-detecting geometry. The dimensions of extended cylindrical sources as well as self-absorption in the source material were considered. (auth)

24277 MEASUREMENT OF THE GAS CONSTANTS FOR VARIOUS PROPORTIONAL-COUNTER GAS MIXTURES. Wolff, R. S. (Columbia Univ., New York). Nucl. Instrum. Methods; 115: No. 2, 461-463(1974).

The relationship between proportional-counter gain and the properties of the gas can be expressed in terms of a semiempirical relationship. Measurements have been made to verify the validity of this expression, and values of the gas constants for various mixtures have been measured. (auth)

24278 IDENTIFICATION AND SPECTROMETRY OF CHARGED PARTICLES PRODUCED IN REACTIONS INDUCED BY 14 MeV NEUTRONS. Perroud, J. P.; Sellem, C.; Loude, J. F. (Univ., Lausanne, Switzerland). Nucl. Instrum. Methods; 115: No. 2, 357-364(1974).

Differential cross sections of (n, charged particle) reactions have been studied using the coincident neutron beam defined by detection of the α-particles emitted in the neutron production reaction ^{3}H(d,n)^{4}He. The target was placed in the neutron beam and a telescope, consisting of two proportional counters and a solid-state detector, could be rotated around it. The energy loss, residual energy and time-of-flight of the charged particles have been registered for each event. A method has been developed which, taking into account these three parameters and their dispersions, allows an unambiguous identification of all charged particles with an energy over 1 to 2 MeV and a drastic reduction of the background. (auth)

24279 PULSED BIAS OPERATION FOR SURFACE-BARRIER DETECTOR. Saeki, B.; Okamoto, M. (Konan Univ., Japan). Nucl. Instrum. Methods; 115: No. 2, 355-356(1974).

A study was made of the properties of a pulsed bias operation for n-type silicon surface-barrier detector. These properties were compared with those of a dc biased operation. Measurements were carried out on the energy response and pulse-height resolution of the ionizing particle. The agreement of the energy response between pulsed bias and dc bias operation of the detector is satisfactory. (auth)

24280 GaSe AS NUCLEAR PARTICLE DETECTOR. Manfredotti, C.; Murri, R.; Vasanelli, L. (INFN, Bari, Italy). Nucl. Instrum. Methods; 115: No. 2, 349-353(1974).

GaSe grown by means of chemical transport and the Bridgman method has been tested with ^{241}Am α-particles for application as a nuclear detector. Collection efficiency ranges from 5 to 40%, corresponding to $\mu\tau^{+}$ products between 10^{-7} and 1.5×10^{-6} cm^{2}V^{-1}. Energy resolution can be as low as 6%. The main handicaps to better performances seem to be due to sample inhomogeneities and injecting contacts; improvements are in the range of present technology. Particular applications of this type of detector are also suggested. (auth)

24281 SCINTILLATION COUNTER FOR USE IN A TELESCOPE FOR GAMMA-RAY ASTRONOMY. Andresen, R. D.; Arens, I.; Taylor, B. G.; Wills, R. D. (ESTEC, Noordwijk, Netherlands). Nucl. Instrum. Methods; 115: No. 2, 531-537(1974).

A plastic scintillation counter has been developed for use in the gamma-ray astronomy experiment to be carried by the ESRO satellite COS-B. The mission requires the ability to measure the number of particles simultaneously traversing the counter over its whole area and within the solid angle defined by the telescope of which it forms a part. To achieve this, a high uniformity of response and good pulse-height resolution are required. Theoretical predictions of these characteristics are presented and compared with measurements carried out with a beam of positrons, which demonstrate that the counter meets the requirements. The resulting reponse to gamma-rays of the counter as part of the complete experiment is briefly discussed. (auth)

24282 LIFETIME MEASUREMENTS OF EXCITED STATES IN ^{219}Rn BY OBSERVATION OF CONVERSION-ELECTRON DOPPLER SHIFTS FOLLOWING α-DECAY. Richter, B.; Martini, V.; Schneider, W. D.; Ley, L.; Schoener, V. (Univ., Bonn). Nucl. Instrum. Methods; 115: No. 2, 401-411(1974).

A method is described in which the observation of conversion-electron Doppler shifts is used to measure nuclear lifetimes in the picosecond range. The isomeric nuclei recoil into the vacuum chamber of an orange-type β-spectrometer following α-emission. The recoil velocity is measured directly by a time-of-flight technique. For the lifetime measurements the recoil distance is limited by a stopper foil, the position of which is varied in a reproducible way using the thermal expansion of a metal holder rod. Since the distances are in the micrometer region, an optical interference method can be applied to measure directly the variation in distance. The fraction of conversion electrons in the unshifted conversion line represents the fraction of isomeric nuclei which do not decay in flight. The nuclear lifetime is derived directly from the variation of this quantity with the recoil distance. This method should be applicable to many excited states of nuclei in the $Z > 82$ region, where common techniques fail. Lifetimes are accessible in the range $1\ ps < T_{1/2} < 100\ ps$. An application to three excited states in ^{219}Rn gave the following results: $T_{1/2}$ (159 keV) = $(17.7 \pm 2.6) \times 10^{-12}$ s, $T_{1/2}$ (269 keV) = $(4.4 \pm 1.0) \times 10^{-12}$ s, and $T_{1/2}$ (339 keV) = $(8.1 \pm 2.8) \times 10^{-12}$ s. (auth)

24283 TECHNIQUE FOR RECOIL DISTANCE LIFETIME MEASUREMENTS. Arai, E.; Ogawa, M.; Ohtani, S. (Tokyo Inst. of Tech.). Nucl. Instrum. Methods; 115: No. 2, 397-399 (1974).

A new technique for recoil distance measurements has been developed. The target is swept by means of an electromagnetic scanner. The electric signal proportional to the recoil distance and gamma-ray pulse are analyzed as two parameters using an on-line computer. The performance is demonstrated by a lifetime measurement of the 0.709 MeV level of ^{30}P. The value (51.8 ± 3.0) ps is obtained. (auth)

24284 HIGH EFFICIENCY NEUTRON DETECTION SYSTEM FOR PHOTOREACTION STUDIES. Dowdy, E. J.; Caldwell, J. T.; Worth, G. M. (Los Alamos Scientific Lab., NM). Nucl. Instrum. Methods; 115: No. 2, 573-579(1974).

A neutron detection system has been constructed to measure neutron multiplicities from photoreactions. The detector consists of fifty-three ^{3}He proportional counters in a polythene cube 61 cm on a side. The detection efficiency for prompt neutrons from spontaneous fission of ^{252}Cf is $\approx 50\%$. The detector is intrinsically insensitive to gamma radiation and has a relatively long ($\approx 30\ \mu s$) neutron dieaway time. These properties, in combination with fast recovery electronics, permit easy measurement of photofission $\bar{\nu}$ and prompt neutron multiplicity distributions with a pulsed electron bremsstrahlung source. The intrinsically low backgrounds experienced with this detector (≈ 0.3 cps) also permit the simultaneous study of very low yield processes such as delayed neutrons following photofission. Calibrations and performance of the system are described. (auth)

24285 NUCLEAR RADIATION COUNTING DEVICE. Jacob, G. (to La Radiotechnique Compelec). French Patent 2,155,773. 4 Oct 1971. 7p. (In French).

A coaxial well-type detector for counting ionizing radiations (in particular β radiations) is presented. It consists of a monocrystalline semiconductor material; a layer of first type of conduction is formed on the outer surface and constitutes the radiation input window; a layer of the second type of conduction (opposite to the first) covers the walls and bottom of the well. The two layers having opposite types of conductivity are separated by an intermediate intrinsic layer. The first type conduction layer, which forms the radiation input window contains complementary impurities leading to the same type of conduction as the monocrystalline semiconductor material in which it is formed. The monocrystalline body is p-type silicon; the layer having the first type of conduction is made of boron; the layer having the second type of conductivity and the intrinsic layer are obtained by successively depositing and diffusing lithium. A medical probe is presented having this type of detector introduced and fixed into a cylindrical metallic casing. (FR)

24286 COUNTER DEADTIME. A Question of Poor Textbook Advice. Diethorn, W. S. (Pennsylvania State Univ., University Park). Int. J. Appl. Radiat. Isotop.; 25: No. 2, 55-60(Feb 1974).

Numerous deadtime equations proposed over the years have needlessly confused the paired source technique and its practice. The ambiguities disappear if the apparently esoteric exact equation is used instead of approximations. (auth)

24287 TEMPERATURE DEPENDENCE OF THE AVERAGE ENERGY PER ELECTRON-HOLE PAIR IN SILICON AND GERMANIUM. Stuck, R.; Ponpon, J. P.; Berger, R.; Siffert, P. (CNRS, Strasbourg). Radiat. Eff.; 20: No. 1-2, 75-80(1973).

The temperature dependence of the average energy ϵ required per electron-hole pair was measured between 10 and 190°K in silicon and germanium radiation detectors, for both γ-ray and α-particle bombardments. The counters were prepared with the most recent techniques in order to minimize charge carrier losses. For example, ultra-high purity germanium and ion implanted contacts were employed. The temperature dependence was found to be the same for α and γ radiations in germanium but not in silicon, and also to be weaker than previously reported. The variation with indirect bandgap E_g was linear in all cases with a slope $\Delta\epsilon/\Delta E_g$ equal to 1.95 for germanium and 1.85 and 2.50 in silicon, respectively for α-particles and γ-rays. (auth)

24288 RECENT ADVANCES IN WHOLE-BODY COUNTING. A Review. Cohn, S. H.; Palmer, H. E. (Brookhaven National Lab., Upton, NY). Int. J. Nucl. Med. Biol.; 1: No. 3, 155-165 (Feb 1974).

An outline review is presented of significant developments in whole-body counting techniques that have occurred since the IAEA Symposium in June 1965. (Clinical Uses of Whole-Body Counting. Proc. Panel meeting, IAEA, Vienna 1966). The subject is dealt with under the following headings: (1) instrument design, single versus multiple detector systems; (2) calibration; (3) new types, including large area plastic scintillator counters, rotational counters, liquid scintillation counters, Compton scattering counting, and the Brookhaven low-level counting facility; (4) automatic data handling; and (5) future developments. (UK)

Radiation Dosimeters

Refer also to abstracts 24474 and 26140.

24289 (AERE-R-7487) NUCLEAR ACCIDENT DOSIMETRY. Part III. Interpretation and Data. Delafield, H. J.; Dennis, J. A.; Gibson, J. A. B. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Dec 1973. 44p. Dep. NTIS (U. S. Sales Only) $4.25. UK £ 1.00.

The general principles of nuclear accident dosimetry have already been described in Part I (AERE-R7485). Detailed procedures for making dose assessments for the U.K.A.E.A. personnel criticality dosimeter and film dosimeter are given in Part II (AERE-R7486). Such dose assessments require to be correlated and interpreted in the context of the particular accident situation. This report gives general guidance on the more important factors to be considered in revising the dose estimates. A worked example is given as an illustration. The required background information is provided in appendices of comprehensive data sheets, covering the characteristics of critical assemblies, dosimeter response data and reaction cross-sections. Supporting calculations are included on the interpretation of the personnel dosimeter and on body sodium activation. (auth)

24290 (BNWL-1777) FOURTH AEC WORKSHOP ON PERSONNEL NEUTRON DOSIMETRY, MIAMI BEACH, FLORIDA, JUNE 14-15, 1973. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. Contract AT(45-1)-1830. 67p. Dep. NTIS $5.45.

The information presented and discussed at the fourth workshop is summarized. Personnel neutron dosimetry research at ORNL, Chalk River Nuclear Labs, BNL, the Dow Chemical Company, LLL, LASL, SLAC, Battelle-Northwest, LBL, and ANL is outlined. (WHK)

24291 (CONF-740212-1) CURRENT STUDIES ON INTEGRATING ENVIRONMENTAL MONITORING AT ORNL. Becker, K. (Oak Ridge National Lab., Tenn. (USA)). 1973. 13p. Dep. NTIS $3.00.

From 2nd environmental radiation workshop; New York, New York, USA (20 Feb 1974).

Recent development work on solid-state environmental monitoring at ORNL includes studies on the sensitivity and other relevant properties of various detectors, with an emphasis on little known materials such as newly developed TL and TSEE phosphors; extensive stability tests under laboratory and field conditions; intercomparison of the methods used in different laboratories;

and attempts to determine average environmental dose-rates over very long (~ 10^2 to 10^4y) periods of time. (auth)

24292 (ORNL-TM-4418) RESULTS OF MEASUREMENTS DURING THE THIRD IAEA INTERCOMPARISON STUDY. Dickson, H. W.; Haywood, F. F. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 14p. (CONF-730562-1). Dep. NTIS $3.00.

From third IAEA nuclear accident dosimetry coordination meeting and intercomparison experiment; Vinca, Yugoslavia (14 May 1973).

ORNL results from the Third IAEA Nuclear Accident Dosimetry Coordination Meeting and Intercomparison Experiment held at the Boris Kidric Institute in Yugoslavia are tabulated. Results are given for moderated multifoil threshold detectors for neutron area monitoring, metaphosphate glass dosimeters for gamma area monitoring, and beryllium oxide TSEE dosimeters for both neutron and gamma personnel monitoring. Measurements were made both in air and on BOMAB style human phantoms. (WHK)

24293 (ORNL-TM-4460) AUTOMATIC SPARK COUNTING OF FAST NEUTRON INDUCED RECOIL PARTICLE TRACKS IN POLYMER FOILS. Becker, K.; Abd-el Razek, M. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 28p. Dep. NTIS $3.50.

Preliminary results are given concerning the automatic spark counting of fast neutron-induced recoil nuclei tracks in thin polymer foils such as cellulose nitrate and polycarbonate, based on extended etching of the foils to the point where electric breakdown begins to occur also in unexposed foils. The method shows promise in personnel dosimetry because it does not require fissionable radiators, and for special studies such as bone-tissue interface dosimetry. Also reported are experiments about the effect of environmental parameters on the characteristics of a spark counter. (auth)

24294 (STR-4) STANDARDIZATION OF RADIATION DOSIMETRY IN THE SOVIET UNION, FRANCE, THE UNITED KINGDOM, THE FEDERAL REPUBLIC OF GERMANY AND CZECHOSLOVAKIA. Report of a Study Tour Conducted 6 May–25 June 1971. Balamutov, V. (International Atomic Energy Agency, Vienna (Austria)). Jul 1973. 101p. IAEA $4.00.

Following six successful large-scale scientific study tours covering different aspects of the peaceful uses of atomic energy, the International Atomic Energy Agency organized a seventh tour devoted to the study of the standardization of radiation dosimetry in the Soviet Union, France, the United Kingdom, the Federal Republic of Germany, and the Czechoslovak Socialist Republic. The tour was organized as an interregional project financed under the Agency's Technical Assistance Program. Twenty-nine participants from 22 countries participated in the study tour, and the keen interest of the World Health Organization in the planning of the tour was evident. The program of the study tour in these five countries consisted mainly of scientific lectures dealing mainly with the metrology of ionizing radiations, visits to national standardizing laboratories and other institutions routinely engaged in radiation dosimetry, and discussions with scientific personnel at these institutes. The visits and discussions are summarized. (WHK)

24295 ABSOLUTE THERMOLUMINESCENCE OUTPUTS OF CRYSTALLINE PHOSPHORS UNDER ALPHA OR GAMMA IRRADIATION. Savikhin, F. A. Tr. Inst. Fiz. Astron., Akad. Nauk Est. SSR; No. 41, 240-242(1972). (In Russian).

Measurements were made of the dependence of the area under the thermoluminescence curve on the α (^{238}Pu) or γ (^{60}Co) dose to the crystalline phosphors ZnS–Cu, ZnS–Cu, Co with different Co concentrations, ZnS–Bi, CaS–Bi, CaS–In, KCl–In, KCl–In, Ag, and KBr–In. Values are given for the ratios in time, of the emitted thermoluminescence energy to the absorbed energy, upon α or γ irradiation in the field where there is no overlapping of excited volumes. It is shown that, by varying the preparation conditions and the compositions of the sample, it is possible to change the energy output upon α and γ irradiation and their ratio. (tr-auth)

24296 POSSIBILITY OF NEUTRON MEASUREMENTS WITH THE MODIFIED CHLORAL HYDRATE DOSIMETER. Moos, W. S.; Brunner, H. (IAEA, Vienna). Int. J. Appl. Radiat. Isotop.; 25: No. 1, 43-45(Jan 1974).

An assessment has been made of the possibility of the use of standard chloral hydrate dosimeters for the quantitative measurement of neutron radiation in the presence of a γ field. Preparation of the dosimeter solutions is described. Investigation of the possible effects of boric acid addition on the optical qualities of the solution indicated slightly decreased optical transmission values for all boric acid containing solutions. Samples of control chloral hydrate solutions (two different concentrations) and those containing boric acid were subjected to fast or thermal neutron irradiations. The results of these are tabulated. Solutions without boric acid essentially respond only to the γ component present during irradiation, whereas thermal neutrons cause about a 15 to 30 times greater response in the boron-chloral hydrate solution. The predominant reaction is ^{10}B(n,α)Li. The boron reaction gives rise to an alpha particle and lithium recoil. In 94% of the reactions a 0.48-MeV γ ray is emitted from the decay of the excited state of ^{7}Li to the ground state. These internally produced radiations most likely contribute very heavily to the chemical reactions in the dosimeter solutions. Some nonlinearity was observed above 2×10^{12} n/cm^2 due to a saturation effect at such high doses. As it was expected on the basis of various physical parameters, sensitivity to fast neutrons is smaller. (UK)

24297 COMPARATIVE INVESTIGATIONS OF CHARACTERISTICS OF VARIOUS TL DOSIMETERS. Niewiadomski, T.; Jasinska, M.; Ryba, E. (Inst. of Nuclear Physics, Krakow). Nukleonika; 18: No. 11, 535-549(1973).

In order to study the possibility of using various TL dosimeters and phosphors for comparisons of dosimetric data of different irradiation facilities, several types of commercially available LiF:Mg, Ti materials were investigated with regard to their dosimetric behavior within the exposure range 50 to 1000 R. It was found that all the materials exhibit qualitatively common properties, with some quantitative differences in glow curve shape and luminescence yield arising when changing the radiation energy and increasing the dose. The differences also depend on read-out conditions, hence, if high measurement accuracy is to be achieved, no dose response data found in the literature could be used: the behavior of the actually used and correctly annealed material batch must be measured exactly for those exposure and read-out conditions in which the dosimeters are used. The appropriate calibration procedure and use of some control dosimeters (which are capable of detecting uncontrolled changes in dosimetric characteristics) together with the measuring ones allows the measurement errors to be reduced to a value of 1 to 2% SD, not only in laboratory conditions but also during the real measurements. (auth)

24298 ACCUMULATION OF ENERGY BY ZnS–Cu CRYSTALLINE PHOSPHORS ON PHOTO- AND GAMMA IRRADIATION. Savikhin, F. A. Tr. Inst. Fiz. Astron., Akad. Nauk Est. SSR; No. 41, 79-98(1972). (In Russian).

The dose dependencies of TL integrated response of ZnS-Cu with high emission efficiency (0.95 ± 0.05) have been measured for uv and γ-rays excitations. It has been shown that electron-hole pairs created by uv light within fundamental absorption, diffuse in the crystal at an extended distance. The experimental evidence of deep trap saturation in ZnS-phosphors was obtained. From comparison of the dose dependencies for uv and γ-rays excitations the mean energy ϵ required to form an electron-hole pair in ZnS was found within the range $2E_g \leq \epsilon < 3E_g$, where E_g means the intrinsic bandgap in ZnS. (auth)

24299 VICTOREEN R-METER LINEARITY AND THE STEM/END-CAP EFFECT. Orton, C. G.; Seibert, J. B. (New York Univ., NY). Radiology; 110: No. 3, 732-733(Mar 1974).

Victoreen R-meters exhibit a nonlinear exposure response for high-energy radiations if the stem and end cap are included in the beam. For 12 chambers tested, the average sensitivity range was 7.5 ± 0.9% for ^{60}Co radiation. If the rear of the stem and end cap are excluded from the primary radiation beam, nonlinearity is substantially reduced. Recommendations are made on the use and calibration of these instruments. (auth)

24300 REMOTE DEVICE FOR THE CONVERSION OF DATA FROM A MULTICHANNEL REMOTE DOSIMETRIC SYSTEM. Gertsovskii, A. F.; Mukhortov, S. S.; Ul'yanov, V. A. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 21, 121-126 (1973). (In Russian).

A description is given of the construction of a multichannel remote dosimetric system. The method for the conversion and transmission of data is examined. The possibility of the automatic control of the efficiency of the device is discussed. A brief description is given of the operation of the device and the experimental results obtained. (tr-auth)

24301 INPUT UNIT OF A MULTICHANNEL DOSIMETRIC SYSTEM. Gertsovskii, A. F.; Klimov, A. N.; Nemirovskii, B. V. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 21, 52-58(1973). (In Russian).

A brief comparative analysis is given of input units for multichannel dosimetric systems. The method of sequential-parallel group measurements and the modification of the device operating by this method are described. The experimental results are reported. (tr-auth)

24302 AUTONOMOUS MODIFICATION OF A REMOTE DOSIMETRIC INSTALLATION. Nazarenko, S. B.; Tarasov, V. F. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 21, 59-65(1973). (In Russian).

The possibility of a modification of the construction of a remote dosimetric autonomous installation with large work capacity from an autonomous power supply is examined. The selection of the operating regime of the autonomous installation and its basic units are proposed. The process of coding and transmission of measurement results is examined. A description is given of the operation of the installation. Experimental data are reported. (tr-auth)

24303 REPEATED EVALUATION OF TL-DOSIMETER (CaF_2) VALUES THROUGH UV-PHOTOSTIMULATION. Konschak, K. (Technische Univ., Dresden). Isotopenpraxis; 9: No. 10, 362-365(Oct 1973). (In German).

By means of uv-stimulated thermoluminescence in natural CaF_2, repeated readouts on TL-dosimeters are possible in the range of 50 to 3000 rad. The uv-sensitivity of luminophor appears as an unwanted signal, which is suitable for creation of an uv-dosimeter. (auth)

24304 GAMMA DOSIMETRY WITH ULTRAVIOLET-TRANSMITTING PLEXIGLAS. Bassim, M. N. (Ecole Polytechnique, Montreal). Nucl. Instrum. Methods; 115: No. 2, 525-529(1974).

The effect of gamma radiation from two previously uninvestigated sources, namely a manganese isotope cell and a nuclear reactor after shutdown, on the optical properties of ultraviolet-transmitting plexiglas was studied to determine the possibility of using this material for dosimetry. The relation between the optical density and the total integrated dose from both sources was found to be linear, thus favoring the use of the plastic for dosimetry. However, for decay gammas from the reactor, the relation is linear only when the plastic is kept at a low temperature (0°C) during exposure to radiation. The effect of bleaching was also investigated. It was found that lowering the temperature preserves the induced optical density for a long time. Storing under vacuum did not affect the rate of bleaching to a great extent. (auth)

24305 INTEGRATING RADON PROGENY AIR SAMPLER. Schiager, K. J. (Colorado State Univ., Fort Collins). Amer. Ind. Hyg. Ass. J.; 35: No. 3, 165-174(Mar 1974).

An air sampler that utilizes a thermoluminescent dosimeter to obtain a time-integrated measurement of airborne radon progeny was developed as a personal monitor for uranium miners. The sampler was adapted for use in homes in Grand Junction in connection with the uranium mill tailings survey. The requirements for a tamper-proof, inexpensive sampler, with a noise level not exceeding 35 db at one meter, introduced challenging design problems. The design, construction, and subsequent operation of the samplers are discussed. (auth)

24306 ENVIRONMENTAL DOSIMETER OF THE THERMOLUMINESCENT TYPE. Eichner, F. N.; Kocher, L. F. (to United States Atomic Energy Commission). US Patent 3,789,227. 29 Jan 1974. Filed date 18 May 1973. 8p.

A dosimeter for accurately monitoring normally low-energy radiation including a thermoluminescent CaF phosphor enclosed within a tantalum capsule is described. The tantalum acts as a filter to weaken the measured dose due to photons having energies below about 0.2 MeV. Tantalum end caps are maintained on the capsule body by a polyolefin sheath formed from heat-contractable tubing. After exposing the dosimeter to environmental radiation, it is placed in a shielded chamber for about 24 h and subsequently annealed at about 80°C to release radiation energy accumulated in low-temperature traps. The dosimeter is then disassembled and the phosphors photometrically read at temperatures about 80°C to determine the absorbed radiation dose. (Official Gazette)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 23952 and 24897.

24307 (AD-763825) NUCLEAR SPECTROMETER STUDIES. Final Technical Report on Phase 2, 1 January 1972–31 March 1973. Ludlum, R. L.; Ellis, J. W. (Texas Instruments, Inc., Dallas (USA)). May 1973. Contract F44620-72-C-0046. 90p. (TI-UI-853801-F; AFOSR-TR-73-1107). NTIS $6.50.

The research was conducted to design, develop, fabricate, and establish operational feasibility of a gamma-ray spectrometer system for use in a nuclear radiation research program. Application requirements specified a man-portable, self-powered instrument for remote field data collection of gamma-ray spectra. High resolution of gamma-ray energy was of primary importance. The system was assembled using an intrinsic germanium detector in conjunction with essentially off-the-shelf, commercially available devices. The units were laboratory-tested and operational feasibility was demonstrated as most of the performance design goals were attained. (auth)

24308 (CEA-CONF-2469) CHAPTER VI. Instrumentation in Slow-Electron Spectrometry. Ballu, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 1973. 120p. (In French). (CONF-730226-1). Dep. NTIS (U. S. Sales Only) $8.00.

From meeting of the center of scientific and technical actualization on the present methods of study of gas-surface interactions; Lyon, France (6 Feb 1973).

An in-depth review is given of instrumentation in slow electron spectrometry. The electron optical elements are first discussed. Methods for the production and analysis of electron beams are described. Methods for the detection of electron beams are considered. (110 references) (JSR)

24309 (CEA-N-1676) STUDY AND DEVELOPMENT OF A SPECTRA ACQUISITION DEVICE HAVING A VARIABLE CAPACITY AND SIZE. Huet, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France)). Oct 1973. 69p. (In French). Dep. NTIS (U. S. Sales Only) $5.50.

A storage memory device is presented whose characteristics (number of channels and channel capacity) are matched to the shape of the spectrum to be measured. The device can function independently or be controlled by a computer. It is particularly well suited to the acquisition of 8192 channel spectra with a maximum count rate per channel different over each half of the spectrum or to the simultaneous acquisition of two 4096 channel spectra whose count rates may differ by a ratio as high as 16. (FR)

24310 (IFA-CRD-53-1973) PROGRAMS FOR THE CALCULATION OF THE SPECTRA OF CHARGED PARTICLES IN THE CONTINUUM. Chevarier, A.; Duma, M.; Hollinger, G. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 14p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

In order to facilitate the treatment of continuous spectra of charged particles obtained in the experiments performed at the I.A.P. Cyclotron some subroutines were written in the FOCAL language for a PDP-8/I computer. These subroutines perform the following functions: determination of the incident beam energy; measurement of the solid angle of the detector using the Rutherford elastic scattering; energy calibration by using the kinematics of a known nuclear reaction; and normalization of the spectra itself. (auth)

24311 (JINR-P10-7614) EXPRESS PROCESSING OF γ-SPECTRA ON THE BASIS OF MINI COMPUTERS. Khabenikht, V.; Khan, G.; Eler, G.; Gopych, P. M.; Vinel, G.; Vylova, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 13p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A set of programs is constructed for a fast preliminary processing of γ-spectra using the HP2116C computer. Control with the help of a dialog through the display allows one easily to store the data, to process them and to obtain the results during the experiment. (auth)

24312 ANALYSIS OF THE OPERATION OF THE ELECTRODYNAMIC DRIVES FOR MOESSBAUER SPECTROMETERS. Shamov, A. I. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 18, 104-117(1972). (In Russian).

The electrodynamic drive system in which the movable part is suspended on springs is examined. It is shown that the spring has a great effect on the speed and stability of the system. An analysis was made of the drive system with vibrators of the springless type with the simultaneous consideration of all factors affecting the degree of control. Calculations are given of the correcting circuit for reverse coupling of the vibrator. (tr-auth)

24313 FAST TUNNEL DIODE DISCRIMINATOR FOR NUCLEAR SPECTROMETRY. Samdani, M. G. (Atomic Energy Centre, Dacca, India). Nucl. Sci. Appl., Ser. B; 6: 1-6(Oct 1973).

A fast discriminator incorporating a tunnel diode is described which can operate up to a pulse rate of 20 MHz. The discriminator output is in the range of 1 V/ns which is fast enough for most nuclear spectrometry involving time measurement pulses. It has shown extremely good results against changes in temperature, count rate and incremental variation in input amplitude. (auth)

24314 GAMMA RESONANCE SCINTILLATION DETECTOR. Dolenko, A. V.; Egiazarov, B. G.; Kazanskaya, V. A.; Raikhman, E. M. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 20, 35-41(1973). (In Russian).

A promising detector for γ resonance radiation—a $^{119}SnO_2$-based γ resonance scintillation detector—is examined. Its advantages in comparison with the usual non-resonance detectors are shown. Comparative experimental data are reported. (tr-auth)

24315 PHOTOELECTRON SPECTROMETRY: A NEW APPROACH TO X-RAY ANALYSIS. Krause, M. O. (Oak Ridge National Lab., TN). Advan. X-Ray Anal.; 16: 74-89(1973).

From applications of x-ray analysis conference; Denver, Colorado, USA (2 Aug 1972). See CONF-720801-.

Photoelectron spectrometry is shown to be an excellent technique for the analysis of x rays in the ultrasoft and soft x-ray regions. X rays are converted into photoelectrons which are ejected from a suitable atomic level, and the photoelectrons are analyzed with an electron spectrometer. The method is energy dispersive, provides a resolution ranging from 0.1 eV at 20 eV to 1.1 eV at 3 keV, and gives well-defined intensity characteristics throughout the range. The energy range can be extended into the 10 keV decade. Properties of the new technique are discussed, compared with conventional techniques, and exemplified by a series of measurements which include determination of the emission spectra of M x rays of yttrium to rhodium, L x rays of zirconium, and the band structures of molybdenum and holmium. (auth)

24316 SOME NEW METHODS OF PRECISION X-RAY SPECTROMETRY. Das Gupta, K.; Welch, H.; Gott, P. F.; Priest, J. F.; Cheng, S.; Chu, E. (Texas Tech Univ., Lubbock). Advan. X-Ray Anal.; 16: 251-259(1973).

From applications of x-ray analysis conference; Denver, Colorado, USA (2 Aug 1972). See CONF-720801-.

Three novel methods of x-ray spectrometry have been developed in recent years. These are: (1) three crystal spectrometer; (2) two curved crystal spectrometer; and (3) spherically bent crystal spectrometer. The new design features and experimental results are discussed to indicate the usefulness of the new instruments. The three crystal spectrometer is a modified two crystal instrument. A third crystal is used to analyze the output of the two crystal spectrometer. The first two crystals are operated as a standard two crystal spectrometer. The third crystal is swept through the spectrum transmitted by the first two crystals for each setting of the first two crystals. The peak intensity of the third crystal sweep corresponds to the energy setting of the two crystal spectrometer, and is the intensity used to plot the spectral lines. The two curved crystal spectrometer utilizes two transmission spectrographs with radii having a 2 : 1 ratio in series, the crystal with the smaller radius being set so that its focal point falls on the Rowland circle of the larger radius crystal. This instrument has a very low background intensity and is suitable for precision scattering and diffraction work. The spherically bent crystal spectrometer makes use of high light gathering power and high orders of reflection to allow high resolution studies of weak spectral lines. It also has the advantage of ease of alignment and operation. (auth)

24317 EVALUATION OF THE ENERGY DISPERSIVE DETECTOR AS A DETECTOR-FILTER SYSTEM FOR THE X-RAY DIFFRACTOMETER. Carpenter, D. (Technical Equipment Corp., Denver); Thatcher, J. Advan. X-Ray Anal.; 16: 322-335 (1973).

From applications of x-ray analysis conference; Denver, Colorado, USA (2 Aug 1972). See CONF-720801-.

A comparison of the relative merits of the energy dispersive detector-pulse height analyzer, scintillation detector-graphite monochromator, and proportional detector-pulse height analyzer combinations is given. Typical energy dispersive detectors are not configured for maximum efficiency on the diffractometer. Being only on the order of 3 mm diameter, a good deal of the available information is not collected by the detector. This is especially true with the wide optics found in modern diffractometers. The energy dispersive detector incorporated into this system is optimized for the x-ray diffractometer. Its detection area is a 1.25 × 0.25 inch rectangle. The resolution is only sufficient to remove the Kβ portion of the spectrum. Conventional diffractometer techniques incorporate either a scintillation detector-crystal monochromator, or a proportional detector-pulse height analyzer combination. The question posed is "what are the advantages in signal to noise ratio and pulse height distribution of the energy dispersive-pulse height analyzer over the more conventional arrangements." (auth)

24318 SHAPE FUNCTION OF PHOTOPEAKS FOR GAMMA-RAY SPECTRUM ANALYSIS WITH Ge(Li) DETECTORS. Dojo, M. (Japan Atomic Energy Research Inst., Ibaraki). Nucl. Instrum. Methods; 115: No. 2, 425-429(1974).

An analytical shape function for peak fitting is described which represents the shapes of γ-ray photopeaks obtained with a Ge(Li) detector. A combined function of a gaussian, an exponential, and an error function, with four shape parameters, is employed for a photopeak, assuming that the peak consists of three components, i.e., the totally absorbed, the slightly degraded, and the more degraded one. The statistical and systematical errors in the fitting are examined for real γ-ray peaks. (auth)

24319 VERSATILE SEMICONDUCTOR BETA SPECTROMETER. Fellmann, S.; Patt, B. (Univ., Marburg, Ger.). Nucl. Instrum. Methods; 115: No. 2, 413-418(1974).

A spectrometer using semiconductor counters has been developed. It was designed for the investigation of short-lived radionuclides with complex β-spectra, the determination of relative abundances and shape factors, the measurement of conversion coefficients and ratios as well as different types of angular correlations ($\beta\gamma$, γe^-, βe^-). In preliminary measurements the temperature dependence of the energy resolution for electrons was investigated for several Si(Li)-detectors in the temperature range from ambient temperature to −180°C. With regard to electron angular correlation investigations, careful anisotropy measurements of the experimental equipment were carried out, yielding for the experimental anisotropy $A = (0.1 \pm 0.2)\%$. Finally, comprehensive investigations due to backscattering of the electrons out of semiconductor counters were performed. These results are confirmed by corresponding measurements in conjunction with a magnetic Siegbahn–Slaetis intermediate image spectrometer. (auth)

24320 GENERAL INTERFACE CIRCUIT FOR TIME-OF-FLIGHT MEASUREMENTS WITH COLD NEUTRONS. Coppo, M.; Maino, G.; Villa, S. (Instituto di Fisico Sperimentale del Politecnico di Turin). Nucl. Instrum. Methods; 115: No. 2, 393-395 (1974).

This article describes a high-speed data acquisition circuit acting as an interface between a neutron detector assembly and a PDP 11/20 processing computer. The system used as storage memory has a fast buffer and its interface with the computer allows an excellent resolution in the study of cold-neutron scattering based on TOF (time-of-flight) technique. The system assures a high reliability in data storage and transfer, with a low time occupation of the computer which is free, for most of its time, to process other programs. (auth)

24321 DEPTH SELECTIVE MOESSBAUER-EFFECT MEASUREMENTS BY MEANS OF SCATTERED ELECTRONS. Baeverstam, U.; Ekdahl, T.; Bohm, C.; Ringstroem, B.; Stefansson, V.; Liljequist, D. (Univ. of Stockholm). Nucl. Instrum. Methods; 115: No. 2, 373-380(1974).

A method is described for performing ME-measurements in a scattering geometry where arbitrary depth layers in the scatterer can be examined. The method, which may have a depth resolution of better than 50 Å, is based on a statistical treatment of the energy loss of the resonance scattered conversion electrons. Energy loss distributions of 7 keV electrons scattered in iron-films are determined and ME-measurements are performed on enriched iron and stainless steel. From these measurements spectra emanating from different depth layers in the scatterer are calculated. (auth)

24322 FIELD MAPPING THE DIPOLE MAGNETS FOR THE UNIVERSITY OF COLORADO ENERGY-LOSS SPECTROGRAPH. Prull, D. E.; Schery, S. D. (Univ. of Colorado, Boulder). Nucl. Instrum. Methods; 115: No. 2, 339-344(1974).

Using a comparatively inexpensive mechanical hoop and Hall effect probe it was possible to map the dipole magnets of the University of Colorado's energy-loss spectrograph with a precision of 1 part in 10^4 for the integrated value of magnetic field along bending radii through the magnets. The limiting factors in precision were an instability of field measurements caused by electronic noise and neglect in interpolation calculations of a measured asymmetry of the magnetic field about the median plane. Hall effect errors caused by regions with gradients and higher derivatives in the magnetic field, although potentially a serious problem, were found less important in the present case because of the small extent of such regions compared to the larger uniform field regions. (auth)

24323 γ-DISCRIMINATING ^{3}He–SEMICONDUCTOR SANDWICH SPECTROMETER. Bluhm, H. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Instrum. Methods; 115: No. 2, 325-337 (1974).

The construction and testing of a ^{3}He-semiconductor sandwich spectrometer for in-core and out-of-core neutron spectrum measurements in the energy region from 100 keV to 5 MeV are described. The spectrometer is able to discriminate against γ-background and to correct for energy losses in the target. Therefore it has been possible to extend considerably the useful energy range of the classical ^{3}He-spectrometer. The geometrical efficiency of the spectrometer is calculated using a Monte Carlo program; in addition it is determined experimentally with monoenergetic neutrons. In a number of measurements the reliability of the spectrometer is demonstrated by comparison with other independent techniques. (auth)

24324 MEASUREMENTS OF TIME-DEPENDENT FAST NEUTRON SPECTRA WITH AN NE 213 SCINTILLATOR. Pieroni, N.; Rusch, D.; Wattecamps, E. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Instrum. Methods; 115: No. 2, 317-323(1974).

An NE 213 liquid scintillator was used to measure time-dependent fast neutron spectra of pulsed small assemblies. The detector provided both nanosecond timing accuracy and linear pulse-height analysis in a dynamic range of 1:200 without appreciable pulse-shape discrimination losses above 300 keV. A flexible code, called "TRADI," was developed to deduce the neutron spectrum from the measured pulse-height distribution. The performance of the detector and the associated code "TRADI" were verified by measuring known spectra. In addition, "TRADI" evaluations were compared with results from the more elaborate "FERDOR" unfolding procedure. The investigation demonstrated that the spectrometer is a suitable tool for the measurement of time-dependent spectra in the energy range from 0.4 to 6 MeV, or higher if the flux is small above 6 MeV. The application of the spectrometer is illustrated by the measurement of the time-dependent spectrum of a pulsed natural uranium cylinder. (auth)

24325 FAST-NEUTRON SPECTRUM MEASUREMENT BY A STILBENE SCINTILLATION SPECTROMETER. Cvachovec, F. Czech. J. Phys.; 24: No. 1, 48-54(1974).

A stilbene scintillation spectrometer for continuous fast-neutron spectra measurement is described. Discrimination of gamma rays is achieved by utilizing differences in the shapes of scintillation pulses produced by recoiled protons and electrons. In addition, results of measurements of fast-neutron spectra of the reactor beam are given. (auth)

24326 HIGH-RESOLUTION ALPHA SPECTROSCOPY WITH LIQUID SCINTILLATORS BY OPTIMIZATION OF GEOMETRY. Hanschke, T. Hanover; Technische Univ. (1972). 65p. (In German).

Thesis.

The influence of the scintillator geometry and photocathode sensitivity on the resolving power in α-spectroscopy was studied. Since the reflection factor of the coating of the scintillator cells is smaller than unity, the number of photons reaching the photocathode of the photomultiplier (PM) varies depending on the place of scintillation. The resulting minimum peak width is calculated for the scintillator being inserted in a small glass sphere covered by the hemispherical reflector cap, and for the spherical scintillator cell being fused on to the hemispherical reflector cap. The influence of the geometry can be kept small for both types of cells. The influence of the nonuniform photocathode sensitivity of the PM on the resolving power is largely determined by the scintillator geometry. Measurements have shown that flat-shaped scintillators (cylindrical cuvettes, cuvettes fused on to the reflector cap) can only be used with good photomultipliers (homogeneous photocathode) for α-spectroscopy, whereas with the type of cells where the scintillator sphere is covered by the hemispherical reflector cap, satisfactory resolution is achieved even with very inhomogeneous photocathodes. The energy needed to produce a photon is estimated. As an example of the applicability of α-spectroscopy for samples of low activity, the determination of the radioactivity of natural river water is discussed. (GE)

24327 DETERMINATION OF THE ENERGY RESOLUTION OF THE Q3D MAGNETIC SPECTROGRAPH USING MAGNETIC FIELD MEASUREMENTS. Goldschmidt, M. Heidelberg; Univ. Heidelberg (1972). 94p. (In German).

Thesis.

A beam guidance system was constructed for the Heidelberg Q3D-spectrograph which permits particle beam transmissions of more than 90% with a collimator window of 0.7×7 mm^2. Spectroscopy is possible with particles whose magnetic rigidity does not exceed that of 25 MeV tritons. Depending on path radius and excitation, pulse resolutions of $P/dP = 7$ to 11×10^3 (FWHM) are expected. (GE)

24328 ENERGY-DISPERSIVE X-RAY DETECTORS. Long, J. V. P. (Cambridge Univ., Eng.). pp 228-232 of Scanning Electron Microscopy: Systems and Applications 1973. London; Institute of Physics (1973).

From conference on scanning electron microscopy: systems and applications; Newcastle upon Tyne, Eng. (3 Jul 1973).

The use of lithium drifted silicon detectors for X-ray analyses using scanning and transmission electron microscopes is described. Pulse processing circuits, background removal in quantitative analysis, and beam switching are discussed. The energy dispersive detector is now a very powerful tool, which for many but not all problems in X-ray analysis is superior to the crystal spectrometer. (UK)

24329 ANALYSIS OF X RAYS USING A NEW COMBINATION OF WAVELENGTH AND ENERGY DISPERSIVE TECHNIQUES. Rees, J. H.; Balmer, V. J. (Cambridge Scientific Instruments Ltd., Eng.). pp 250-253 of Scanning Electron Microscopy: Systems and Applications 1973. London; Institute of Physics (1973).

From conference on scanning electron microscopy: systems and applications; Newcastle upon Tyne, Eng. (3 Jul 1973).

A system was designed in which a new crystal spectrometer was interfaced to the data processing electronics of the energy dispersive system. The energy range was 0 to 40 kV with the crystal spectrometer covering the 0 to 2 kV range. The spectrometer and integrated system are described and the use of a proportional counter is discussed. (UK)

High Energy Physics Instrumentation

Refer also to abstract 24875.

24330 (ANL/HEP-7405) STUDIES OF A POSSIBLE TRIGGER FOR STUDYING Ξ-PRODUCTION IN THE STREAMER CHAMBER. Schultz, P. (Argonne National Lab., Ill. (USA)). [nd]. 14p. Dep. NTIS $3.00.

A brief summary of studies of how one might trigger the streamer chamber for the purpose of studying production of Ξ^- hyperons in K^-p interactions is given. The study involves investigating the trajectories of particles in the streamer chamber; the events used are real events from experiment E6 (K^-p at 5.5 GeV/c) in the interactions (a) $K^-p \rightarrow \Xi^- + \ldots$, (b) $K^-p \rightarrow K^-p\pi^+\pi^-$, and (c) $K^-p \rightarrow K^-p\pi^+\pi^-\pi^0$. Interactions (a) are the desired ones; (b) and (c) were used for investigating background. Various triggering schemes using threshold Cherenkov counters and hodoscopes are discussed. (WHK)

24331 (CEA-N-1671) REFRACTOMETRY WITH SOLID SUBSTANCES HAVING LOW REFRACTIVE INDICES. Bourdinaud, M.; Poivilliers, J.; Taulemesse, C.; Thevenin, J. C. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). Oct 1973. 12p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

Various methods tested for measuring the refractive index of two new types of Cherenkov radiator (silica powder, silica gel) are described. One of these methods gives refractory results which are in agreement with theoretical predictions ($n = 1.20$). (FR)

24332 (JINR-P13-7610) RECONSTRUCTION OF THE THREE-DIMENSIONAL MAGNETIC FIELD OVER ITS VALUES MEASURED AT THE BOUNDARY OF THE CONSIDERED VOLUME. Vorozhtsov, S. B.; Lebedev, R. M.; Lytkin, L. K.; Somov, L. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 13p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

In order to represent the three-dimensional field within the useful volume, a scalar magnetic potential $\Phi(X,Y,Z)$ is computed. The measured boundary field components are integrated to give the potential distribution along the surfaces. A method is given to solve the problem of corrected planar Hall effect. But even if the systematic error due to the uncorrected planar Hall effect is not taken into account, it is largely eliminated by the application of Laplace's equation. The program was verified by the analytical expression of the magnetic field. The magnetic field of a 100 cm magnetic spectrometer at the Laboratory of High Energies was computed by means of this method. The difference between the measured and computed fields is shown. The kinematic values of particles were computed by finding and measuring the fields. (auth)

24333 PROPERTIES AND PERFORMANCE OF A MULTIWIRE PROPORTIONAL CHAMBER. Decker, D. Stuttgart; Univ. Stuttgart (1972). 141p. (In German).

Thesis.

The properties and performance of a multiwire proportional chamber and the corresponding calculations are discussed in detail. The following topics are discussed: layout of the chamber, variation of field intensity and degree of homogeneity as a function of chamber geometry, gas magnification as a function of the voltage applied and chamber geometry within the proportional band and within the range of limited proportionality, distribution of pulse amplitude and the influence of the collimation of the source (pulse rise time, counting time, time-dependent resolution, influence of the type of gas used and R_C unit, integrating and differentiating external wiring of the chamber, optimization of the wiring, interference pulses due to capacitive disturbances and influence), detector characteristics (as a function of primary ionization and geometry, reproducibility, spatial resolution), detection of thermal and subthermal neutrons (sensitivity, discriminating power, particle localization), as well as detection of x-rays and low-energy gamma radiation. (GE)

24334 ANALYSIS OF THREE-BODY EVENTS IN $\gamma + D \rightarrow \pi^- + p + p$. Blum, D.; Boucrot, J.; McGill, W.; Grossetete, B.; Nguyen Ngoc, H. (Univ. Paris, Orsay, France). Nucl. Instrum. Methods; 115: No. 2, 563-572(1974).

The analysis of three-body events in a pion photoproduction experiment on deuterium is described. Two outgoing particles (pion and proton) have been analyzed by a set of nine multiwire proportional chambers in a magnetic field. We describe the method used to extract good events from raw data on tape; a matching technique has been employed to find the good trajectory from a set of base trajectories. We give the method of computation of these base trajectories in the inhomogeneous magnet field. As a monochromatic beam of photons has been used, momentum and angle of the second proton can be computed from three-body kinematics. The principle, results and tests of the analysis are given. (auth)

24335 WIRE SPARK CHAMBERS WITH MAGNETOSTRICTIVE READOUT. Madaras, R. (Harvard Univ., Cambridge, MA); Litke, A.; Wilson, R.; Law, L.; Little, R.; Paterson, J. M.; Hanson, G. Nucl. Instrum. Methods; 115: No. 2, 581-604(1974).

The design criteria, construction details, and developmental tests of magnetostrictive spark chambers, particularly those used in the colliding beam experiments at the Cambridge Electron Accelerator, are described. Also, results of tests on efficiency, resolution, and shower detection of positrons and photons are presented. (auth)

24336 HYBRID AMPLIFIER AND MEMORIZATION CIRCUITS FOR MULTIWIRE PROPORTIONAL CHAMBERS. Schultz, G.; Chatelus, Y.; Berst, J. D.; Schaub, G. (Univ. Louis Pasteur, Strasbourg). Nucl. Instrum. Methods; 115: No. 2, 605-614(1974).

A new hybrid circuit for multiwire proportional chambers is described. Amplification and memorization circuits are independent and separated by approximately 30 meters of twist pair wire. Results of electronic tests on 14 prototypes (amplifier and memorization) are given as well as control tests for a larger series. (auth)

24337 BUBBLE CREATION BY ELECTRONS FROM TRITIUM DECAY IN A HYDROGEN BUBBLE CHAMBER. Horlitz, G. (DESY, Hamburg); Wolff, S.; Harigel, G. Nucl. Instrum. Methods; 115: No. 2, 365-372(1974).

The formation of single bubbles by β-electrons from the decay of tritium has been investigated in the DESY 85 cm hydrogen bubble chamber. The probability of bubble formation was measured at 24.8 K and 25.7 K and for different dynamic pressures. The atomic tritium concentration (c = number of tritium atoms/number of hydrogen atoms) varied between 10^{-15} and 10^{-11}. A method for extrapolating the results to deuterium is described. (auth)

24338 MOMENTUM ANALYSIS BY USING A QUINTIC SPLINE MODEL FOR THE TRACK. Wind, H. (CERN, Geneva). Nucl. Instrum. Methods; 115: No. 2, 431-434(1974).

A method is described to determine the momentum of a particle when the (inhomogeneous) analysing magnetic field and the position of at least three points on the track are known. The model of the field is essentially a cubic spline and that of the track a quintic spline. (auth)

24339 LARGE DETECTOR FOR SLOW K^+ MESONS. CERN-Imperial College-Southampton Collaboration. Nucl. Instrum. Methods; 115: No. 2, 435-443(1974).

A large detector for K^+ mesons of momentum up to about 600 MeV/c is described. It is suitable for use in a multiparticle spectrometer for selecting events in which a slow K^+ is produced. It consists of layers of scintillation counters and brass absorbers. The method of selection relies on the detection of delayed secondaries from the decay of stopped kaons. The K^+ detection efficiency depends on the desired rejection level of other particles: for example, it is 51% with a rejection factor of 120 against π^+ and 33% with a rejection factor of 3×10^4. (auth)

24340 DESIGN AND DEVELOPMENT OF A 1.5 METER STREAMER CHAMBER SYSTEM. Abashian, A. (Univ. of Illinois, Urbana); Beamer, N.; Eisenstein, B. Nucl. Instrum. Methods; 115: No. 2, 445-456(1974).

A 1.5 m × 1.0 m × 0.6 m Ne–He streamer chamber and high voltage pulsing system capable of 1.0 MV pulses with widths continuously variable from 10 to 20 ns has been developed by a University of Illinois–ANL group. The design and construction of the dc fast charge regulator, Marx generator, Blumlein pulse shaping network, transmission line, and chamber are described. Studies on the effects of increasing field emission and injection of free electrons into the pulse shaping network gap on pulse amplitude stability are reported. Under normal operating conditions, pulse amplitude stability of 2 to 3% rms has been achieved. Photographic and pulse monitoring systems are described and operating experience over two experimental runs is summarized. (auth)

Radiometric Instruments

Refer also to abstract 24210.

24341 (SGAE-2153) NONDESTRUCTIVE THICKNESS MEASUREMENT OF INSIDE AND OUTSIDE COATINGS OF ALUMINUM TUBES. Roetzer, H.; Markowitsch, P. (Oesterreichische Studiengesellschaft fuer Atomenergie Ges.m.b.H., Seibersdorf). Jul 1973. 13p. (CONF-720447-1). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on industrial measurement and control by radiation techniques and exhibition; Guildford, UK (11 Apr 1972).

A device for quick, nondestructive measurement of the thickness of inside and outside coatings of aluminium tubes is described. The method is based on the principle of x-ray fluorescence. The measuring head contains a proportional flow-counter and a tritium-zirconium bremsstrahlung source. For measurement, tubes are slipped over the measuring head. The counting rate is kept constant and the measuring time is shown on a display. The result is readout from a calibration curve. For inside coatings the measuring time is about 20 s with an accuracy of ± 3.5%, for outside coatings the measuring time is about 8 s with an accuracy of ± 2.5%. The apparatus has been in use for almost two years in the laboratory for quality control of an Austrian tube producing firm. (auth)

24342 ARTIFICIAL STANDARDS FOR CALIBRATION OF AIRBORNE, FIELD PORTABLE, AND LOGGING GAMMA SPECTROMETERS. Matolin, M. (Charles Univ., Prague). pp 125-139 of Uranium Exploration Methods. Vienna; International Atomic Energy Agency (1973).

From panel on uranium exploration methods; Vienna, Austria (10 Apr 1972). See STI/PUB-334; CONF-720487-.

Gamma spectrometers used in prospecting for uranium ores are calibrated at calibration stations which may be located on natural geological structures, or constructed by artificial standards. Artificial standards should fulfil the physical and geometrical conditions of calibration of field gamma spectrometers. The shapes and dimensions of the standards for airborne, field portable and logging spectrometers are different. The shape of the gamma spectrum, the intensity of gamma radiation and the influence of the composition of the standard on the values measured in calibrating the apparatuses are discussed. Problems are discussed concerning the standards containing loose material with a suitably chosen concentration of U, Th and K, which is enclosed in a firm envelope. The choice of material for manufacture of the standards, the radioactive equilibrium in the standards, the effect of the envelope of the standard and the dimensions and locations of the standards are treated separately. To enhance the accuracy of calibration, the radioactivity of the standards is chosen higher than that in rocks. The specified parameters of the standards for calibration of field gamma spectrometers can be applied in constructing a calibration base in an area where gamma-spectrometric measurements are to be carried out. (auth)

24343 FUTURE DEVELOPMENT IN THE USE OF GAMMA-RAY SPECTROMETRY FOR URANIUM PROSPECTING ON THE GROUND. Loevborg, L. (Danish AEC Research Establishment, Risoe). pp 141-153 of Uranium Exploration Methods. Vienna; International Atomic Energy Agency (1973).

From panel on uranium exploration methods; Vienna, Austria (10 Apr 1972). See STI/PUB-334; CONF-720487-.

The significance of a uranium anomaly can often be most readily estimated from γ-spectrometric measurements of the ratio between the concentration levels of uranium, thorium, and potassium. This technique lends itself to remote sensing from aircraft, surveying by car or on foot, and examination of collected material. Today, a large selection of γ-spectrometers especially designed to meet the uranium prospector's requirements are commercially available, and even more compact, high-performance instruments can be expected on the market in the future. However, statistically meaningful radioelement determinations can only be made if sufficiently large scintillation crystals are used, so there is a lower limit to the size and weight of any usable γ-spectrometer. Successful use of portable γ-spectrometers depends on the future availability of suitable calibration standards at strategic places in or near the world's major uranium districts. Future possibilities for fast interpretation of uranium anomalies are largely dependent on the efficiency in the use of digital computers for the processing of γ-spectrometric data. (auth)

24344 RP-60 RADIOACTIVE-ISOTOPE DENSIMETER. Kreyndlin, I. I.; Mukhin, S. S.; Novikov, V. S.; Pravikov, A. A. Tr., Vses. Nauch.-Issled. Inst. Radiats. Tekh.; No. 7, 80-86 (1972). (In Russian).

A general view and schematic diagram are presented for an apparatus for measurement of density of soils by a gammascopic method. The operation of the densimeter is based on transmission of a beam of gamma rays, for example, those provided by ^{60}Co with an activity of 0.16 μC, through the object being tested, and measurement of the attenuation of the rays by the object being studied, in this case soil. The densimeter includes a sensor, a converter, an intensimeter (with strip chart recorder) and power supply with nominal voltage 12 V. The measurement range of the densimeter is 1 to 2.3 g/cm; the measurement error is 0.08 g/cm; the sensor has a probe diameter of 61 mm; measurement depth is 5 m; the operating temperature ranges from −10 to +40°C. The RP-60 radioactive densimeter has passed state testing and is recommended for series production. (Referativnyi Zh.)

24345 SELECTED ISOTOPE INSTRUMENTS OF THE VEB RFT MESSELEKTRONIK "OTTO SCHOEN" DRESDEN FOR THE RATIONALIZATION OF INDUSTRIAL PROCESSES. Schubert, G. Technical Meeting No. 8/3. Basel; Nuclex (1972). 11p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The construction, operation, and characteristics of measuring equipment using radionuclides for filling level control, the measurement of thickness, and the determination of mass per unit area as well as for material analysis are discussed. (auth)

24346 APPARATUS FOR DETERMINING THE LEVEL AND PROFILE OF A MATERIAL. Afanasiev, V. N. US Patent 3,792,252. 12 Feb 1974. Filed Date 23 Nov 1970. 8p.

An apparatus for determining the level and profile of materials, in which a collimated radiation source has a servo and produces a beam of hard electromagnetic radiation reflected from an irradiated zone on a surface being gaged and picked up from a receiving zone by a collimated detector also having a servo is described. The two servos are controlled by individual amplifiers in accordance with signals received from an electrically connected means for sensing relative alignment between the irradiated and receiving zones, one amplifier accepting signals corresponding to the amount of misalignment between the two zones with only one sign, according to the magnitude of which it brings down the speed of the associated controlled servo, and the other amplifier accepting signals corresponding to the amount of misalignment between the two zones. (Official Gazette)

24347 RECENT APPLICATIONS OF RADIOMETRIC PROCESS CONTROL. Kosmowski, A. Konstr., Elem., Method.; No. 4, 113-116(Apr 1973). (In German).

The technical and economic advantages of the method, the technical state of development and the measuring techniques (such as transmission tests, backscattering tests, x-ray fluorescence testing) are briefly outlined and new fields of application of these methods are discussed. The examples from the plastics industry include process control by digital computers, coating processes, measurement of wall thickness in the production of film tubes and plastic tubes, and thickness and density measurements in the production of plastic foams. In the paper industry, the methods are applied in the automatic system "Cepamat", in the continuous measurement of filler materials in moving paper sheets and the measurement of paper weight per surface unit. The metal industry uses the methods for the measurement of the thickness of tin layers by means of x-ray fluorescence analyses and the determination of band thickness of light-metal foils. (GE)

24348 WEIGHT PER UNIT AREA GAGES USING NUCLEAR RADIATION. Part 1. Design and Properties of Current Types of Equipment. Waechter, K. H. Arch. Tech. Mes. Messtech. Praxis; 454: No. 11, 207-210(Nov 1973). (In German).

In the fabrication of sheets or continuous webs, the weight per unit area is an important quality criterion. In most cases it is measured by the absorption or backscattering of nuclear radiation. Different types of measuring systems are reviewed. (GE)

24349 DEVICE FOR NON-CONTACT GAUGING OF THICKNESS AND WEIGHT PER UNIT AREA OF SHEET MATERIALS AND FILMS. Prilipko, I. T.; Pankratov, V. I.; Gomberg, M. L.; Momonov, J. M.; Zhikharev, V. L. (to Urainsky Nauchno-Issledovatelsky Institut Tselljulozno-Bumazhonoi Promyshlennosti). British Patent 1,338,157. 21 Nov 1973. Filed date 28 Jul 1971. 5p.

A device is described that is comprised of a radioactive source and a radiation detector placed on the same side of the material to be examined, with magnetic means located between the source and detector, the magnetic means being arranged so that its field, on interacting with the radiation particles from the source, deflects them back through the material on to the detector and disperses them according to their energy levels. The magnetic means may comprise a permanent or electromagnet. A diaphragm may be located in front of the detector for separating particles of the required energy level from the flow of dispersed radiation. An additional detector may be located in the area traversed only by the direct radiation from the source, which has not passed through the material, and connected differentially with the first detector in order to provide a difference signal indicating the quantity required to be measured; this reduces the dependence of the measurement on changes in the characteristics of the source and the surrounding medium with time. Disadvantages of earlier methods are indicated. The arrangement described makes the device highly sensitive, even if relatively low-response detectors are employed, on account of the double absorption of radiation in the material, and it ensures a broad range of measurement into a single source, since the measurement range can be changed by shifting the detector into areas traversed by particles having higher or lower energies, rather than by changing the radiation source. Depending on the thickness, or weight per unit area, of the material being gauged the degree to which it absorbs radiation varies, as also do the signal voltages. The recording instrument is calibrated in units of thickness, or weight per unit area, against standard specimens. The device may be employed in controlling the production and processing of paper, textiles, films, and other materials. (UK)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

24350 (AD-764357) LITHIUM-DOPED SILICON SOLAR CELLS STATE-OF-THE-ART. Technical Report, April–October 1972. Green, J. M. (Air Force Aero-Propulsion Lab., Wright–Patterson AFB, Ohio (USA)). Jun 1973. 42p. (AFAPL-TR-73-4). NTIS $4.25.

The present status of lithium-doped solar cells is reported. Improvements in fabrication techniques have made possible lithium-doped cells which are 11.9% efficient at AMO conditions and 28°C. Cell areas of 12 cm^2 are now feasible. Annealing characteristics are highly temperature dependent with 60°C being the minimum array temperature for good performance. The recovered power levels of N/P and P/N lithium-doped cells after exposure to electron and neutron radiations are compared. The use of lithium-doped cells is recommended for missions which require solar arrays to operate at temperatures above 60°C, especially if the satellite must survive a nuclear weapon environment. (auth)

24351 (BARC-697) EFFECT OF NUCLEAR RADIATION ON THE ELECTRICAL CHARACTERISTICS OF SEMICONDUCTOR DEVICES. Ramakrishnan, S. S.; Veer Raj Urs, A. S.; Monteiro, C.; Patwardhan, P. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 34p. Dep. NTIS (U. S. Sales Only) $3.75.

Experimental observations on the degradation of electrical parameters of indigenously manufactured bipolar transistors under nuclear reactor radiation are described. The electrical parameters selected for measurement were the current amplification factor, leakage current and saturation voltages. Failure fluences of fast neutrons for different types of transistors have been arrived at from the linear current amplification factor degradation curves; radiation damage constants (K) for the above types have been evaluated. The increase in leakage current has been observed to be linear with fast neutron fluence in the case of silicon types; but non-linear and large changes for germanium types. Failure fluences (under saturation mode) have been arrived at for switching transistors and these failure fluences have been found to be linear with the ratio of (I_B/I_C). (auth)

24352 BIAS-TEMPERATURE TREATMENT ON MOS CAPACITORS IRRADIATED WITH 1 MeV ELECTRONS. Saminadayar, K.; Pfister, J. C. (CEN, Grenoble, France). Radiat. Eff.; 20: No. 1-2, 55-64(1973).

Bias-temperature treatments are performed on MOS capacitors irradiated with electrons. The parameters used are G_M and V_M values of the parallel conductance and the voltage at the maximum of the G−V curve. It is shown that the changes of the induced charges in the silicon and the surface-state density of the oxide-silicon interface during the thermal treatments are not always simply correlated. An increase or a decrease of the surface-state density as well as the induced charge in the silicon can be observed depending on the applied bias during the treatment. (auth)

Miscellaneous Instruments

Refer also to abstracts 23952, 26111, 26112, 26146, and 26234.

24353 (AD-763182) INVESTIGATION OF GAGE-PLACEMENT EFFECTS ON A STRESS GAGE EMBEDDED IN GROUT. Final Report, January–August 1971. Ehrgott, J. Q. (Army Engineer Waterways Experiment Station, Vicksburg, Miss. (USA)). Jun 1973. 75p. NTIS $3.00.

A study conducted on the Gulf Radiation Technology piezoelectric stress gage in support of the Diamond Mine Event at the Nevada Test Site (NTS) is presented. The gage was first calibrated in oil and then embedded in an NTS grout and tested under conditions of uniaxial strain. The results of these tests indicated a slightly nonlinear output of the gage under hydrostatic loadings and an underregistration of the gage when embedded in the grout. Limited uniaxial strain tests were concurrently conducted on the grout mix. The property information from these tests was used as input to the WESTES finite element code in which the test boundary conditions were simulated to analytically investigate behavior of the grout specimen with and without an embedded inclusion or gage. The calculated results indicated that the contact interface between the gage and the grout had the greatest effect on gage performance. (auth)

24354 (BARC-674) ANNUAL REPORT OF TEST EQUIPMENT AND DISPLAY SYSTEMS SECTION, ELECTRONICS DIVISION, 1971-1972. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 37p. Dep. NTIS (U. S. Sales Only) $4.00.

The instruments and display systems developed at Bhabha Atomic Research Center are briefly described and specifications tabulated. The test equipment developed includes a transistor curve tracer type OS 779, rf millivoltmeter, probes for oscilloscopes, high input impedance probe, and a dc millivoltmeter. Display systems developed include a dual trace adaptor, electrocardiodisplay, x–y–z display, and an x–y display. Medical instruments developed include a display system for measurement of myoelectric action potential, an electronic muscle stimulator, and a muscle activity monitor. Also, a solid state 30W af power amplifier is described. (WHK)

24355 (CEA-CONF-2468) AUTOMATIC INSTALLATION FOR THE MEASUREMENT OF WEAK CURRENTS BY INTEGRATION WITH PRINTOUT OF THE RESULTS. Bouet, J.; Prigent, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 82 (France)). [nd]. 6p. (In French). (CONF-730677-2). Dep. NTIS (U. S. Sales Only) $3.00.

From 8th congress of the association of radioprotection technicians; Chatenay-Malabry, France (8 Jun 1973).

An automatic installation for the measurement of weak currents is described. It consists of a measurement head called an amplifier-adapter, a preamplifier, and a numerical voltmeter. The factors governing the selection of the preamplifier are given. (JSR)

24356 (CEA-CONF-2494) CAMAC MODULES AUTOMATIC TESTING. Realization and Execution of Automatic Testing Programs. Guerin, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). 16 Nov 1973. 12p. (In French). (CONF-731213-1). Dep. NTIS (U. S. Sales Only) $3.00.

From 1st international symposium on CAMAC and on-line computers; Luxembourg (4 Dec 1973).

To test CAMAC modules that were industrially fabricated, a method was developed which consists mainly in writing "test programs" specific to each module. They give diagnostics of failures and their localization. Sub-programs facilitate the writing of the main program and make it independent of the CAMAC configuration. These sub-programs can be also used in quickly writing programs using CAMAC. (auth)

24357 (IPA-ER-4-1973) MODULAR SYSTEM CAMAC. Patrutescu, M. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 31p. (In Rumanian). Dep. NTIS (U. S. Sales Only) $3.75.

Economical and technical considerations regarding the use of CAMAC systems in nuclear electronics are discussed. (auth)

24358 (JAPFNR-141) DEVELOPMENT OF A HIGH TEMPERATURE STRAIN GAGE. II. Yuuki, H.; Kania, K.; Yamura, Y. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works). Dec 1973. 57p. (PNC-N-251-73-3). Dep. NTIS (U. S. Sales Only) $5.00.

The development and performance of a Pt–W–wire resistance-type strain gage for strength measurement of various construction materials used in fast breeder reactor plants are described. (TFO)

24359 (RISO-M-1681) AUTOMATIC PRESSURE CONTROL IN THE REGION BETWEEN 10^{-3} AND 10^{2} mm Hg. Hansen, J. W. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1974. 20p. (In Danish). Dep. NTIS (U. S. Sales Only) $3.00.

The development of a closed loop regulation system designed to measure and maintain a constant pressure in a dynamic vacuum system is described. The equipment consists of a Pirani type vacuum gauge and an electronically controlled leak valve. (auth)

24360 (SGAE-2202) CAMAC: TEST-MODUL. Marschik, W.; Schoeberl, E. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Elektronikinstitut). Dec 1973. 10p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

A module supporting the programming and used for testing of CAMAC-Systems is described. The module consists of a storage and a display of each standard-dataway-lines, as well as switches for R-lines and the Q-line and keys for generating a LAM-Signal or for generating an internal signal conforming to S1. (auth)

24361 (UCRL-Trans-1507) STABILITY OF COHERENT OSCILLATIONS OF AN ELECTRON RING IN RESONATOR. Part I. Azimuthal Oscillations. Aleksakhin, Yu. I.; Korenev, I. L.; Yudin, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. Translated by G. Brodell from JINR-P9-7065. 41p. Dep. NTIS $4.25.

The stability of the electron ring oscillations in a cylindrical resonator is considered. The beam impedance is calculated taking into account the finite conductivity of the chamber walls. The beam stability with the energy spread both in resonances and out of them is analyzed. (auth)

24362 SMALL COMPUTER IN A NUCLEAR MEDICINE DEPARTMENT. Dugdale, L. M. (Alfred Hospital, Melbourne). Australas. Bull. Med. Phys. Biophys.; No. 60, 3-9(1 Dec 1973).

The major tasks of the computer are as follows: (1) accumulation, manipulation, and display of data for imaging equipment; (2) manipulation of data required from sample counting systems; (3) storage of patient data; and (4) handling of data in statistical tests, and simulation trials (5) record keeping and ordering of isotope supplies. (AT)

24363 USE OF CHERENKOV COUNTER TO DETERMINE THE CONTENT OF CERTAIN ELEMENTS IN SOLUTIONS BY THE NEUTRON ACTIVATION METHOD. Kartashev, E. R.; Chulkin, V. L.; Shtan, A. S. Tr., Vses. Nauch.-Issled. Inst. Radiats. Tekh.; No. 7, 118-123(1972). (In Russian).

A table of elements is presented, solutions of which form isotopes during activation analysis upon bombardment by neutrons which emit high-energy beta particles. It is suggested that the concentration of these elements be determined using a Cherenkov counter as a detector. An installation is developed, consisting of an activation chamber with neutron source surrounded by a moderator, a measurement chamber, systems providing for even pumping of the solution being analyzed through the measurement and activation chambers, and recording apparatus. The measurement chamber has a cylindrical shape with nipples for injection and withdrawal of the solution. The walls of the chamber are coated to provide diffuse reflection. The ends of the chamber are made of organic glass, in optical contact with the output windows of an FEU-56 photomultiplier. Devices of this type can also be used to determine leakage of fissionable products in the cooling system of a reactor. (Referativnyi Zh.)

24364 APPLICATION OF NUCLEAR INSTRUMENTS IN SYSTEMIC MONITORING OF ENVIRONMENT POLLUTION. Isakov, L. M.; Matveev, V. V. At. Energ. (USSR); 35: No. 6, 417-422(Dec 1973). (In Russian).

Problems of application of nuclear methods and instruments in the fabrication of environment pollution monitoring systems are considered. It is shown that it is expedient to use for such purposes experience and specific devices from the field of nuclear instrumentation. (auth)

24365 CONSTRUCTION OF A DECIMAL COUNTING CIRCUIT. Andreitsev, P. P.; Belov, A. F.; Kurkov, E. V.; Dotsenko, Yu. Yu. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 18, 65-73(1972). (In Russian).

Questions on the improvement of the speed of response and reliability of single channel scalers, used in devices for the registration of particles and pulses, by use of optimum circuits for the subassemblies are examined. The structure of the scaler consists of fast, medium, and slow scalers on which are imposed different requirements for speed of response, reliability, and cost. (tr-auth)

24366 INTEGRATED CIRCUIT SCALERS. Belov, A. F.; Dotsenko, Yu.Yu. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 18, 74-85(1972). (In Russian).

In radiation measurements and measurements of other nuclear physics parameters, decade counters find a wide application. Some integrated circuit scalers both with and without hanging elements were analyzed. Different structures of the single-discharge double counter were proposed for construction of multidischarge counters and double decimal decades. Some applications of double decimal decades including reverse decades without distortion of the data during reversal are also proposed. (tr-auth)

24367 SYSTEM OF INSTRUMENTS AND UNITS FOR THE NUCLEAR ELECTRONIC DEVICE VEKTOR. Kurochkin, S. S.; Kiselev, L. G.; Murin, I. D. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 18, 90-103(1972). (In Russian).

The characteristics of the system of instruments and units of the fourth generation nuclear electronic device "Vektor" are examined. The "Vektor" system has microelectronics, high-compensating micro-components, and digital elements. In construction, logic operation, and coupling the "Vektor" system is close to the western systems CAMAC and NIM, but the system is designed on the basis of domestic standards and assembly manufacture. The characteristics of the systems connected with it and the principal design standards are examined. The composition of the system and the basic characteristics of its instruments and units are discussed. (tr-auth)

24368 PIEZOELECTRIC ULTRASOUND TRANSDUCER FOR HIGH TEMPERATURE USES. Roule, M.; Saglio, R. (to Commissariat a l'Energie Atomique). French Patent 2,152,348. 6 Sep 1971. 9p. (In French).

Ultrasound transducers capable of retaining their piezoelectric properties at high temperatures are used in displacement measuring devices for liquid sodium-cooled reactors. A piezoelectric ultrasound transducer in which monocrystalline piezoelectric pellets are fixed by their active faces to a common support is described. These pellets are regularly distributed in at least one circle centered about the axis of the device and located in a plane perpendicular to this axis. The pellets are electrically connected in parallel in such a method as to ensure that the sound waves emitted by them are in phase. (FR)

24369 LOGARITHMIC DIGITAL-ANALOG CONVERTER. Klimashov, A. A.; Khazanov, B. I. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 22, 91-95(1973). (In Russian).

In the construction of instruments for radiation measurements logarithmic converters of the number of registered pulses into analog units are necessary. The construction of a digital-analog converter with logarithmic characteristics is examined. In order to reduce the criticality to nominal resistors sequential introduction of the current from a series of cascades is realized. The construction of a pulse counter operating on the "wave" principle and controlled by current diode switches is described. (tr-auth)

24370 USE OF COMPUTERS IN PHYSICS EXPERIMENTS IN THE VEKTOR SYSTEM. Kurochkin, S. S.; Murin, I. D. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 21, 3-11 (1973). (In Russian).

A block diagram of the measurement-calculation system, designed on a computer basis, of the "Vektor" is examined. The standardized channels for the transmission of data are also considered. (tr-auth)

24371 USE OF AN X-RAY RADIOMETRIC ANALYZER FOR THE SAMPLING OF ORES OF APATITE DEPOSITS. Ashitok, V. I.; Baldin, S. A.; Bol'shakov, A. Yu.; Migulya, V. S. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 21, 40-45(1973). (In Russian).

The circuit and construction of an x-ray radiometric type FAM3-01 analyzer are examined. The results of its application to the sampling of P in deposits of its natural occurrence using the correlating dependence of the P content on the rare earth element content are discussed. (tr-auth)

24372 USE OF A 100-CHANNEL AMPLITUDE ANALYZER FOR MEASUREMENT OF TIME SPECTRA. Andreev, V. K.; Fertman, D. E. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 22, 100-105(1973). (In Russian).

The possibility of using a 100-channel amplitude analyzer with ultrasonic delay line memory for the measurement of time spectra is examined. A block diagram of the input device is given. Experiments on the study of the neutron capture γ radiation in water and concrete are described. (tr-auth)

24373 IMPROVEMENTS TO TECHNIQUES FOR EVALUATING THE POROSITY OF FORMATIONS TRAVERSED BY A WELL. Attali, G. (to Societe de Prospection Electrique Schlumberger). French Patent 2,159,557. 3 Nov 1971. 15p. (In French).

A process is described for automatically calculating the porosity of geological formations traversed by a well from measurements of the velocity of sound, the density and the hydrogen contents associated with the same samples from the formation. These three measurements are made on relatively narrow sectors of the formation, at every instant of time these sectors being aligned with the same generatrix of the well. An application of this technique to an elongated approximately cylindrical sample is presented: a sonic diagraphy device provided with at least one sound source and two sonic detectors; a density diagraphy device provided with a γ ray source and two radiation detectors; a neutron diagraphy device provided with a neutron source and two neutron or γ ray detectors. (FR)

24374 HIGH-SENSITIVITY ESCA INSTRUMENT. Davies, R. D.; Herglotz, H. K.; Lee, J. D.; Suchan, H. L. (E. I. du Pont de Nemours and Co. Inc., Wilmington, DE). Advan. X-Ray Anal.; 16: 90-101(1973).

From applications of x-ray analysis conference; Denver, Colorado, USA (2 Aug 1972). See CONF-720801-.

A new electron spectroscopy for chemical analysis (ESCA) instrument has been developed to provide high sensitivity and efficient operation for laboratory analysis of composition and chemical bonding in very thin surface layers of solid samples. High sensitivity is achieved by means of the high-intensity, efficient x-ray source described by Davies and Herglotz at the 1968 Denver X-Ray Conference, in combination with the new electron energy analyzer described by Lee at the 1972 Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy. A sample chamber designed to provide for rapid introduction and replacement of samples has adequate facilities for various sample treatments and conditioning followed immediately by ESCA analysis of the sample. Examples of application are presented, demonstrating the sensitivity and resolution achievable with this instrument. Its usefulness in trace surface analysis is shown and some "chemical shifts" measured by the instrument are compared with those obtained by x-ray spectroscopy. (auth)

24375 PROCESSING OF ENERGY DISPERSION X-RAY DATA IN A TIMESHARING COMPUTER. Marr, H. E.; Campbell, W. J. (Bureau of Mines, College Park, MD). Advan. X-Ray Anal.; 16: 206-216(1973).

From applications of x-ray analysis conference; Denver, Colorado, USA (2 Aug 1972). See CONF-720801-.

A time-sharing computer was used in conjunction with a semiconductor detector and radioisotopic sources to evaluate energy dispersion x-ray analysis for the rapid analysis of copper base alloys. The time-sharing computer served two purposes: to aid in the development of the analytical method and to simulate the action of a dedicated computer that would eventually be used as part of an on-line analytical device. Some of the general capabilities of time-sharing computers are discussed with some emphasis on the differences between the computer requirements of energy dispersive x-ray methods and conventional x-ray spectrography. An annular source of americium-241 was used with a secondary fluorescer to excite 23 brass and bronze alloys. The 400 channel spectrum from a multichannel analyzer was recorded on paper tape. A telephone coupled teletype was used to transmit the x-ray spectrum to the central processing facility. Curve fitting and statistical analysis programs similar to those available from most commercial time-sharing computer operations were utilized as well as other programs written at this laboratory for processing digitized spectra. (auth)

24376 AUTOMATION OF A MANUAL SPECTROMETER BY USE OF A HARDWIRED ANGLE PROGRAMMER AND MICROCOMPUTER. Croke, J. F.; Jenkins, R. (Philips Electronic Instruments, Mount Vernon, NY). Advan. X-Ray Anal.; 16: 273-283 (1973).

From applications of x-ray analysis conference; Denver, Colorado, USA (2 Aug 1972). See CONF-720801-.

The manual x-ray spectrometer, PW-1410, has been upgraded to a level of automatic operation through the addition of a hardwired angle mode programmer, a motor programmer, and by interfacing a dedicated microcomputer. The system and the data reduction software developed for the microcomputer are described. Also, quantitative analysis techniques using matrix mass absorption coefficients measured with a new absorption cell attachment are discussed. (WHK)

24377 INTEGRATED SYSTEM FOR ELEMENTAL X-RAY ANALYSIS OF MATERIALS. Russ, J. C.; Sandborg, A. O.; Barnhart, M. W.; Soderquist, C. E.; Lichtinger, R. W.; Walsh, C. J.

(EDAX Int'l, Inc., Prairie View, IL). Advan. X-Ray Anal.; 16: 284-297(1973).

From applications of x-ray analysis conference; Denver, Colorado, USA (2 Aug 1972). See CONF-720801-.

A new system for elemental x-ray analysis of materials (EXAM) has been designed using x-ray fluorescence with energy dispersive analysis of x-rays. The EXAM system incorporates a specimen chamber with airlock for continuous sample introduction. The excitation is normally with bremsstrahlung from an x-ray tube which combines efficient uniform excitation of many elements with excellent uniformity across the specimen and minimum detectable limits in the ppM range. The instrument stability, reproducibility and count rate linearity are all excellent so that accurate, rapid analysis is feasible. (WHK)

24378 RAPID FLUORESCENCE AND ENERGY POWDER PATTERN ANALYSIS SYSTEM. Lin, W. (Cornell Univ., Ithaca, NY). Advan. X-Ray Anal.; 16: 298-309(1973).

From applications of x-ray analysis conference; Denver, Colorado, USA (2 Aug 1972). See CONF-720801-.

A computer-coupled energy dispersive x-ray system is described that is capable of performing rapid elemental analysis and phase identification employing fluorescence and energy powder pattern analyses. The system consists of a Si(Li) detector, commercial diffractometer, vacuum specimen chamber with fluorescence geometry and a multichannel analyzer interfaced to a laboratory computer. The continuous radiation is used to excite both fluorescent x-rays and Bragg reflections. The diffractometer spectrum obtained with a fixed 2θ setting gives the crystalline diffraction pattern plus the detectable emission lines. With the fluorescence geometry, the system is capable of detecting the characteristic x-rays of the elements down to Na. The fluorescent spectrum can be used to separate the diffraction peaks from the emission lines in the diffractometer spectrum. Furthermore, the fluorescent spectrum can be used for qualitative or/and quantitative elemental analysis. Software was developed for element recognition, to isolate the diffraction pattern from emission lines, d-spacing calculations, as well as matrix corrections and mass fraction determination of elements in quantitative analysis. (auth)

24379 ADJUSTABLE FIELD SHAPE ELECTROSTATIC ANALYZER. Whitehead, T. W.; Chao, B. Y. K. (Rensselaer Polytechnic Inst., Troy, NY). Nucl. Instrum. Methods; 115: No. 2, 381-392(1974).

An electric analyzer which permits the generation of any required field shape has been designed and constructed at Rensselaer Polytechnic Institute to be used with a broad range magnetic analyzer in the mass spectrometry program. The adjustable field shape electric lens is built using 20 elements in a 90° sector upon which voltages may be applied independently. First-order focusing theory for the generalized electric sector is developed using the principle of least action. The initial calculations involving determination of the potential distribution, the calculation of potentials for analyzer elements resulting in the most accurate field shape, and the studies of ion trajectories through the field of the lens are discussed. The details of the analyzer construction and operation are included as well as the techniques used to directly measure the focusing action of the lens during operation. Several related applications for this analyzer concept using modified designs are also mentioned. (auth)

24380 NEW PEAK STRETCHER FOR PULSE-HEIGHT ANALYSIS. Westphal, G. P. (Atominstitut der Oesterreichischen Hochschulen, Vienna). Nucl. Instrum. Methods; 115: No. 2, 509-510 (1974).

A new method of peak stretching is described, which is based on a sample hold circuit working directly on the output of a main amplifier. The hold command is taken from the zero crossing of the first derivative of the signal seen by the sample hold amplifier. Besides its extreme stability and linearity the circuit allows for window discrimination without the need for a delay line and forms a complete front end for an ADC. (auth)

24381 HELIUM-JET TECHNIQUE FOR INACCESSIBLE SOURCES OF ^{252}Cf FISSION FRAGMENTS AND ^{228}Th DECAY PRODUCTS. ASTERIX Collaboration. Nucl. Instrum. Methods; 115: No. 2, 419-424(1974).

A He-jet system has been developed for the transport of ^{252}Cf fission fragments and ^{228}Th decay products. The essential cluster formation occurs in a cluster breeder separated from the radioactive source. This cluster breeding is accomplished by adding liquids such as H_2O or CCl_4 to the transport gas and then blowing the mixture past an uv lamp. The efficiency of the transport from the radioactive source to the end of the capillary ranges between 50 and 80%. The efficiency of the skimming process alone is about 50%. K x-ray spectroscopy indicates that the transport of activity is largely independent of the particular element. (auth)

24382 METHOD AND DEVICE FOR RECORDING VARIATIONS IN ATMOSPHERIC PRESSURE. Rocard, Y. (to Commissariat a l'Energie Atomique). French Patent 2,161,342. 23 Nov 1971. 18p. (In French).

A device for detecting and recording variations in atmospheric pressure is presented. It consists of a sensor having two sensibly identical heat insulated volumes joined by a capillary tube. The size of this capillary is such that the assembly has an acoustical time constant of several minutes. Flexible bellows are positioned in one of these volumes. These bellows are connected by the intermediate of the other volume to an atmospheric pressure sampling network. The free end of the bellows is connected to a part whose displacement modifies an ac electrical parameter. The amplifier and filtering unit used to process this parameter has a pass band extending from several seconds to 300 seconds. The device also possesses recording means. The device is used to detect waves due to high power chemical explosions, atmospheric nuclear and thermonuclear explosions, and earthquakes. (FR)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

24383 (DPSPU-74-30-3) HEAVY WATER: ALTERNATE ROUTE TO NUCLEAR POWER. Garvin, R. G. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). [nd]. 27p. (CONF-740207-1). Dep. NTIS $3.50.

From joint meeting of Society of Engineers and Chapter of American Society of Civil Engineers; Columbia, South Carolina, USA (1 Feb 1974).

The properties, uses, and importance of heavy water in the nuclear power industry are discussed. The 20 year-old multiple-unit facility at the Savannah River Plant and the new large single train plants in Canada are described. (TFD)

24384 (K-C-922) OAK RIDGE GASEOUS DIFFUSION PLANT. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 15 Sep 1967. Contract W-7405-eng-26. 13p. Dep. NTIS $3.00.

A general description of the gaseous diffusion process and the Oak Ridge Gaseous Diffusion Plant are presented. The future demand for enriched uranium is briefly discussed. (TFD)

24385 (LA-tr-74-4) APPARATUS FOR THE SEPARATION OF GAS OR VAPORS, ESPECIALLY ISOTOPES, UTILIZING THE PRINCIPLE OF THE SEPARATION NOZZLE. Bier, K.; Bier, W. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F. R. Germany)). 10 Oct 1968. Translation by Stephen J. Merlan and John E. Dougherty from German Patent 1,279,653. 10p. Dep. NTIS $3.00.

An apparatus for the separation of gases or vapors with different molecular weights and/or different gas kinetic cross-sections, especially isotopes, using the principle of the separation nozzle with feed-channel, curved external nozzle, bending wall, and separating knife edge, is described. (auth)

24386 (ORO-725) ENVIRONMENTAL EFFECTS OF THE CONSTRUCTION AND OPERATION OF A GASEOUS DIFFUSION PLANT. (Goodyear Atomic Corp., Portsmouth, Ohio (USA)). 26 Jul 1973. 33p. Dep. NTIS $4.00.

The impacts upon the environment resulting from construction, start-up, and operation of a gaseous diffusion plant are described. Some of the impacts are typical regardless of location of the plant. Others are atypical and depend upon location; those are presented, by way of example, as they occur at the Portsmouth Gaseous Diffusion Plant. The various environmental contaminants that may be produced in the operating plant are described. The concentrations of those contaminants are stated; and the adverse biological effects of pertinent contaminants are elucidated. UF_6 may be enriched in the Portsmouth Gaseous Diffusion Plant to almost any ^{235}U concentration desired. The environmental impact of the plant varies somewhat according to ^{235}U concentrations. However, commercial plants are not expected to enrich ^{235}U in concentrations greater than 4%; for this reason, environmental effects due to Portsmouth operations within that range are emphasized. The study revealed that present discharges from the plants generally have no detrimental effects upon the environment. (auth)

24387 URANIUM ENRICHMENT: RUMORS OF ISRAELI PROGRESS WITH LASERS. Gillette, R. Science; 183: No. 4130, 1172-1174(22 Mar 1974).

The possibility that Israeli scientists have developed a rapid and economic laser method for separating uranium isotopes is examined. (TFD)

24388 DEVICE FOR THE RELIEF OF THE THRUST BEARING OF A GAS CENTRIFUGE. Badie, M.; Bourgain, L.; Samson, G. (to Commissariat a l'Energie Atomique). German Patent 2,126,224. 10 May 1973. 3p. (In German).

The invention refers to a device for the relief of the lower thrust bearing of a gas centrifuge. The bearing supports the centrifuge drum via the lower shaft end which is also coupled to the rotor of a driving motor arranged below the drum. (GE)

24389 SEPARATION AND APPLICATIONS OF STABLE ISOTOPES. Botter, F. (CEN de Saclay, Gif-sur-Yvette, France); Darras, R.; Leger, D. Bull. Inform. Sci. Tech. (Paris); No. 183, 25-35(Jul 1973). (In French).

The uses of stable radioisotopes are discussed. The principal research already carried out or currently being conducted by the CEA in this field is reviewed, the Chemistry Division being principally concerned. The work undertaken by the production department and by enterprises outside of the CEA is discussed. The various separation methods currently being investigated or in use are mentioned. The method adopted depends on the properties sought which may vary considerably with the different species considered. Most of the applications occur in the nuclear field (heavy water, ^{10}B, and xenon, and krypton), or medical field (^{196}Hg, ^{13}C, and ^{33}S) in which the isotopes are used as tracers or targets. Both applied and fundamental research applications are carried out in these fields. (FR)

24390 ISOTOPIC SEPARATION IN A ROTATING PLASMA. James, B. W.; Simpson, S. W. (Univ. of Sydney). Phys. Lett.; 46A: No. 5, 347-348(14 Jan 1974).

Time resolved measurements of isotope separation produced in a transient rotating neon plasma are presented. Samples extracted from the plasma were analyzed with a mass spectrometer to determine isotopic ratio. (auth)

24391 OPERATION OF THE GASEOUS DIFFUSION ENRICHMENT PROCESS. Dyer, R. H.; Janney, D. B. (Union Carbide Corp., Oak Ridge, TN). IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst.; PAS-92: No. 4, 1180-1185(1973).

The gaseous diffusion process is used to increase the concentration of fissionable uranium-235 above the 0.711% as found in natural uranium. Enrichment of this isotope is necessary to provide fuel to make nuclear power reactors economically attractive. The actual operation of a gaseous diffusion plant is described. (auth)

Radiation Sources

Refer also to abstract 24087.

24392 SURFACE TEMPERATURE OF ^{60}Co SOURCE IN A HEAVY SOURCE TRANSFER CONTAINER. Leung, P. M. K. (Ontario Cancer Inst., Toronto). Brit. J. Radiol.; 47: No. 554, 156(Feb 1974).

Brief comment is made on the design of the ^{60}Co source transfer container of the Ontario Cancer Institute, built to satisfy IAEA recommendations on heat transfer requirements. The simple design enabled the surface temperature of the source to be measured directly. The sensitivity of the thermocouple assembly was 0.05 ± 0.005 mV/°C, the response being linear over a wide range of temperature. For a ^{60}Co source in an international capsule, with a total activity of 5,650 Ci the temperature of the source surface was 75 ± 10°C, while the container surface was <10°C above the ambient temperature. (UK)

Design and Fabrication

24393 SOURCE HOLDER COLLIMATOR FOR ENCAPSULATING RADIOACTIVE MATERIAL AND COLLIMATING THE EMANATIONS FROM THE MATERIAL. Laurer, G. R. (to United States Atomic Energy Commission). US Patent 3,787,691. 22 Jan 1974. Filed date 31 Jan 1973. 12p.

This invention provides a transportable device capable of detecting normal levels of a trace element, such as lead in a doughnut-shaped blood sample by x-ray fluorescence with a minimum of sample preparation in a relatively short analyzing time. In one embodiment, the blood is molded into a doughnut-shaped sample around an annular array of low-energy radioactive material that is at the center of the doughnut-shaped sample but encapsulated in a collimator, the latter shielding a detector that is close to the sample and facing the same so that the detector receives secondary emissions from the sample while the collimator collimates the primary emissions from the radioactive material to direct those emissions toward the sample around 360° and away from the detector. (Official Gazette)

24394 CALIFORNIUM– PALLADIUM METAL NEUTRON SOURCE MATERIAL. Dahlen, B. L.; Mosly, W. C. Jr.; Smith, P. K.; Albenesius, E. L. (to United States Atomic Energy Commission). US Patent 3,787,321. 22 Jan 1974. Filed date 1 Jul 1971. 4p.

Californium, as metal or oxide, is uniformly dispersed throughout a noble metal matrix, provided in compact, rod or wire form. A solution of californium values is added to palladium metal powder, dried, blended and pressed into a compact having a uniform distribution of californium. The californium values are decomposed to californium oxide or metal by heating in an inert or reducing atmosphere. Sintering the compact to a high density closes the matrix around the dispersed californium. The sintered compact is then mechanically shaped into an elongated rod or wire form. (4 claims, no drawings) (Official Gazette)

Industrial Uses

Refer also to abstracts 24116, 24117, 24436, 24444–24446, and 24507.

24395 (AAEC/E-285) SURVEY ON THE USE OF RADIOISOTOPES IN AUSTRALIA IN 1970/71. Ellis, W. R.; Gregory, J. N.; Crivelli, R. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jul 1973. 83p. Dep. NTIS (U. S. Sales Only) $6.25.

The use of radioisotopes in Australia has been surveyed for the year ending June 30, 1971. Questionnaires were sent to licensed medical, industrial and scientific users of radioisotopes. The results of these questionnaires have been used to gauge the extent of the application of radioisotopes in Australia and to forecast likely future requirements. (auth)

24396 (BNL-18399) LARGE SCALE OZONE PRODUCTION IN CHEMONUCLEAR REACTORS FOR WATER TREATMENT. Steinberg, M.; Beller, M.; Powell, J. R. (Brookhaven National Lab., Upton, N. Y. (USA)). Nov 1973. 40p. (CONF-731211-1). Dep. NTIS $4.00.

From first international symposium and exposition on ozone for water and wastewater treatment; Washington, District of Columbia, USA (2 Dec 1973).

The high energy radiation synthesis of ozone has been investigated in basic radiation chemistry studies and in large scale chemonuclear in-pile development loops. The yields for ozone production from gaseous oxygen at high pressures (68 atm) and below ambient temperature (<75°F) indicate G-values of 10 to 15 (equivalent to 2.5 to 1.7 kWh(t)/lb O_3) which is up to 3 times less than the unit energy consumption in electric discharge processes. Chemonuclear isotopic radiation sources such as waste fission product ^{137}Cs and electron accelerators can mainly be considered for treating drinking water or for smaller quantities of sewage effluent in the range of ≈10 Mgd. Chemonuclear fission fragment reactors can be considered for large scale production in the range of hundreds of tons of ozone per day capable of treating waste effluent in the hundreds of Mgd to over a billion gallons per day capacity. Operation of a chemonuclear pilot plant in the Brookhaven Graphite reactor indicated the feasibility of the process for producing a clean ozone stream. While economic estimates indicate costs half that for electric discharge ozonizer costs at these large capacities, the stigma of possible radioactive fission fragment contamination of the product could act as a deterrent to its general use. A chemonuclear fusion (controlled thermonuclear CTR) reactor solves the problem of contamination in that mainly clean penetrating electromagnetic gamma radiation can be used for processing. It is estimated that 30 to 60% of the total energy released from the fusion of deuterium and tritium could be converted to gamma radiation. This avoids the intermediate conversion of thermal energy to electrical energy which is used in turn to convert oxygen to ozone. The fusion gamma chemonuclear (CTR) reactor is a direct, high, capacity, low cost, clean ozone production process technology which awaits the demonstration of a positive nuclear fusion reactor within the next decade. (auth)

24397 (BNL-18423) VARIABLES EFFECTING OZONE TREATMENT OF PHYSICAL-CHEMICAL EFFLUENT. Dietz, R. N.; Pruzansky, J.; Steinberg, M. (Brookhaven National Lab., Upton, N. Y. (USA)). Nov 1973. 22p. (CONF-731211-2). Dep. NTIS $3.25.

From first international symposium and exposition on ozone for water and wastewater treatment; Washington, District of Columbia, USA (2 Dec 1973).

The treatment of raw sewage from an on-site apartment area was investigated in a series of laboratory experiments in which changes in turbidity, pH, total organic carbon, chemical oxygen demand, and, in some cases, biochemical oxygen demands were determined. Raw sewage, but mainly the effluent following physical-chemical treatment, was examined for improvement in discharge quality by ozone treatment in combination with oxygen sparging, ionizing gamma radiation from ^{60}Co heating, acidifying, and several other variables. The average composition of the raw sewage was a TOC of 125 ppM (range from 65 to 240), COD of 190 ppM (range from 85 to 475), turbidity of 145 J. U. (range from 60 to 350), and pH of 7.3 (range from 6.5 to 8.4). Physical chemical treatment usually consisted of the addition of CaO (to pH 11) and $FeCl_3$ as a coagulant aid in an inclined tube followed by course filtration; typical treatment time was 15 minutes giving an average reduction in TOC and COD of 40 to 60%. Subsequent treatment was usually performed with 200 cm^3 samples of the effluent in fine and course fritted bubblers. The combination of radiation plus ozone gave the largest reduction of TOC and COD. In one experiment, 15 minutes of treatment followed by 30 minutes of irradiation and ozonation reduced the raw sewage TOC from 95 to 14 ppM carbon and COD from 150 to 6 ppM oxygen. (auth)

24398 (BNL-18661) FRACTURE ENERGY AND STRENGTH OF POLYMER IMPREGNATED CEMENT. Auskern, A.; Horn, W. (Brookhaven National Lab., Upton, N. Y. (USA)). Feb. 1974. 16p. Dep. NTIS $3.00.

The fracture energy, or effective surface energy of hardened cement paste and polymer-impregnated hardened cement paste, was measured by an analytical method. The fracture energy of polymer impregnated hardened cement paste is considerably higher than the unimpregnated paste (7.5×10^4 to 0.91×10^4 ergs/cm^2). The increase appears to be entirely due to the polymer contribution. The results predict a factor of 5 improvement in the fracture strength of hardened cement paste upon polymer impregnation. (auth)

24399 (INIS-mf-752) GAMMA IRRADIATION INFLUENCE ON STORAGE AND QUALITY OF POTATOES. Vylchev, P. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 14p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Gamma irradiation of three varieties potatoes, early crop, middle-early crop, and late crop, was studied. Tubers were irradiated in the autumn with 8 and 10 kR. Weight losses, starch contents, and culinary alterations were investigated. Irradiated tubers in all three varieties of potatoes did not sprout. At the end of April, weight losses of non-irradiated potatoes were 9 to 14.5%, and of irradiated, 0.5 to 4.5%. After one year of storage these losses were respectively 44 to 56% and 11 to 19%, in relation to the variety and the radiation dose. Tubers infected with Spondylocladium atrovirens Harz were not appropriate for prolonged storage. In the spring substantial differences were not established in the quality of controls and irradiated tubers. After one year storage of irradiated tubers proved to be with lower quality characteristics in comparisons to new crop, but were nevertheless suitable for consumption. (auth)

24400 (INIS-mf-754) DYNAMICS OF ORGANIC ACIDS IN IRRADIATED TOMATOES. Tencheva, S. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 11p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Investigations on the dynamics of organic acids in irradiated tomatoes of the Pioneer 2 variety for radiation purposes were made. The chromatograph column method on silicic acid was utilized. Seven organic acids, five of which were identified, were quantitatively determined. The more intensive reduction of organic acids in irradiated (100 kR) tomatoes occurred in two fundamental acids: citric and malic. The results are given in two tables and two figures. (auth)

24401 (STI/PUB-362) ASPECTS OF THE INTRODUCTION OF FOOD IRRADIATION IN DEVELOPING COUNTRIES. Panel Proceedings Series. Proceedings of a Panel Held in Bombay, India, November 18-22, 1972. (International Atomic Energy Agency, Vienna (Austria)). Dec 1973. 117p. (CONF-721153-). IAEA $6.00.

Eleven papers were presented. A separate abstract was prepared for each paper. (LCL)

For abstracts of individual papers see: 24406–24414, 24444, and 24445.

24402 (UCRL-Trans-1511) ELECTRONIC ANALOG RADIOCARDIOGRAM-SIMULATOR. Roux, G.; Lansiart, A.; de Vernejoul, P.; Kellershohn, C. Translated by H. G. Parker from Med. Biol. Eng.; 7: 57-70(1969). 23p. Dep. NTIS $3.25.

The various parameters of the cardiac pump and blood circulation can be determined by radiocardiographic techniques. The use of traces obtained in radiocardiography are facilitated by the electronic analogue simulator presented. The experimental and simulated radiocardiograms are compared by acting on the electrical parameters of the simulator. The actual physiological parameters are easily deduced from these electrical parameters by means of simple diagrams. Some examples are given which show the great accuracy obtained with the simulator in the determination of ejection indexes. (auth)

24403 RADIOACTIVE ISOTOPES IN AN IMPERIAL SMELTING FURNACE. Biala, N.; Brafman, M.; Fik, H.; Kierzek, J.;

Kurek, R.; Mrowiec, J.; Nowak, M.; Radzikowski, Z. J. Metals; 25: No. 8, 22-30(Aug 1973).

A radiotracer technique for studying zinc reoxidation problems in a blast furnace is described. (TFD)

24404 RESEARCH TRENDS WITH FOOD IRRADIATION IN JAPAN. Sato, T. (Japan Atomic Energy Research Inst., Takasaki). Genshiryoku Kogyo; 19: No. 6, 45-48(Jun 1973). (In Japanese).

Potatoes and onions are irradiated to prevent their germination for 8 months after harvest. Twenty-seven tons of potatoes were exposed to ^{60}Co gamma irradiation at a dose rate of 7 × 10^4 R/hr. Potatoes irradiated with a dose of 7 to 15 Krads were stored for 8 months at room temperature, and were suitable market produce. Sapporo yellow onions, produced in Hokkaido and which passed the year-end for storage, were mainly studied. It was possible to prevent germination of the onions if irradiated at a dose of 3 to 10 Krads within the dormant period. Concerning rice, it was suggested that prevention of the main harmful insects of rice, such as rice weevil, Sordidus zeamais and Sordidus oryzal, was possible by sterilization and inactivation through irradiation at a dose of 15 Krads. The sterilization dose for harmful insects of wheat was 5 to 7 Krads. The off flavor in the wheat was recognized immediately after irradiation at a dose of 20 Krads, but after three months wheat did not show off flavor even with 50 Krads irradiation. As a result, the volume of bread was larger in irradiated bread rather than in nonirradiated bread. Vienna sausage without preservatives was irradiated in 500 Krads under the condition of being kept in cold storage at 10°C. Its decomposition was delayed one week. The proper dose for boiled fishpaste was determined to be 300 Krads, and its preservation period was prolonged from 7 to 10 days to 21 days by irradiation. In mandarin oranges, off flavor was caused by a dose level of 50 Krads of ^{60}Co gamma radiation. Therefore, irradiation of mandarin oranges has to depend on electron irradiation, but problems remain regarding the irradiation technique. In a study of the safety of irradiated food, potato irradiation was permitted by the Ministry of Health and Welfare at a dose of 15 Krads in August of 1972. Lastly, the condition of potato irradiation in the producing and consuming districts and economic problems are discussed. (JA)

24405 ENVIRONMENTAL PROTECTION BY USING RADIATION. Machi, S. (Japan Atomic Energy Research Inst., Takasaki). Genshiryoku Kogyo; 19: No. 5, 16-20(May 1973). (In Japanese).

The utilization of radiation for controlling environmental pollutants such as stack gas, sludge, and microorganisms in waste water is described. The sizes and costs of various irradiation sources such as ^{60}Co, ^{137}Cs, atomic reactors, accelerators, and spent fuel used for waste water treatment are compared, showing accelerators to have the lowest cost, except for atomic reactors. Stack gas with 1000 ppM of SO_2 concentration was irradiated at a dose of 3 Mrad at 100°C irradiation temperature, with 5.5 MeV of electron energy and 70 μA of electric current, and 80 to 90% of SO_2 was eliminated. The electron accelerator was suggested as a suitable irradiation source for treating gaseous bodies with densities less than water. Using irradiation on waste water, it is possible to decompose and eliminate harmful chemical substances that are difficult to treat with microorganisms. The author's experiment, which decreased COD by 100 mg/l using 1.2 Mrad irradiation, was described. Moreover, the following three items were reported: elimination of 11 ppM of ABS (alkyl benzenesulfonate) by 3 × 10^4 rad irradiation, decrease of 25 ppM of cyanogen ion by dose rate of 4 × 10^5 rad/hr., and decrease of 1000 ppM of phenol to 50 ppM by dose rate of 1.74 × 10^5 rad/hr. When difficult to treat sludge was irradiated, its sedimentation speed became faster and its filtration rate increased. Furthermore, it was stated that disinfection by radiation for medical supplies has already been put to practical use and it is also effective for bacteria in husk (spore and viruses) that are difficult to destroy by chemical methods. (JA)

24406 NEED FOR ACTION ON DISINFESTATION OF GRAIN AND GRAIN PRODUCTS BY IRRADIATION. Goresline, H. E. pp 1-5 of Aspects of the Introduction of Food Irradiation in Developing Countries. Vienna; International Atomic Energy Agency (1973).

From panel to consider the application of food irradiation in developing countries; Bombay, India (18 Nov 1972). See STI/PUB-326; CONF-721153-.

It is pointed out that during the last 20 years extensive research has been carried out in many countries proving that ionizing radiation is an effective, efficient and safe treatment method for the control of insects in grain and grain products. Also, that the wholesomeness testing done on irradiated grain has resulted in the legal clearance for human consumption by Canada, USA and the USSR. It is believed that the need is no longer for radiation research on proving that insects can be controlled in grain, but that a shift should be made to the field of experimental implementation into industry and international commerce of the process that has been given legal clearance. To prevent continued losses of food by insect damage an action program to demonstrate this new process commercially is suggested. (auth)

24407 EXPERIENCE IN IRRADIATING POTATOES. Gruenewald, T. (Federal Research Centre for Food Preservation, Karlsruhe, Ger.). pp 7-11 of Aspects of the Introduction of Food Irradiation in Developing Countries. Vienna; International Atomic Energy Agency (1973).

From panel to consider the application of food irradiation in developing countries; Bombay, India (18 Nov 1972). See STI/PUB-362; CONF-721153-.

Earlier research concentrated on the problem of supplying consumers with fresh, unsprouted tubers. Consumers tests have demonstrated that there was no aversion to food irradiation. Research in the last few years has been carried out with the main aim of establishing the suitability of irradiated potatoes for industrial processing and storage. In an international project running for some years, irradiated and chemically sprout-inhibited potatoes were stored for 7 to 9 months and processed into various products of good quality. The increased susceptibility of the irradiated tubers to rotting could be compensated for by improved handling. Observed discolorations are dependent upon the variety. Activities in the developing countries should be directed towards obtaining all information on the local parameters, especially the local varieties, to enable governments to give at least a restricted authorization for potato irradiation. (auth)

24408 PROBLEMS AND PROSPECTS OF RADIATION DISINFESTATION AND SHELF-LIFE EXTENSION OF TROPICAL FRUITS AND VEGETABLES. Moy, J. H. (Univ. of Hawaii, Honolulu). pp 13-20 of Aspects of the Introduction of Food Irradiation in Developing Countries. Vienna; International Atomic Energy Agency (1973).

From panel to consider the application of food irradiation in developing countries; Bombay, India (18 Nov 1972). See STI/PUB-362; CONF-721153-.

The feasibility, effectiveness and need to disinfest tropical fruits and vegetables by gamma irradiation have been adequately proven and well recognized. For papaya, which is infested by 1 to 3 species of fruit flies in various areas of the world, irradiation has several advantages over the accepted fumigation or vapor-heat treatment. Developing countries know the market potential of some of their tropical fruits and vegetables, which usually required disinfestation, but the introduction or application of radiation treatment is faced with several problems. Harvesting technique, post-harvest handling, packaging and transport all need to be improved on or developed. Fear of radioactivity and concern for public health clearance suggest the need for mass education for the educated as well as the less educated. The expense of large-scale experimentation, including animal feeding tests, appears to be a major limiting factor, which might be resolved if several countries with a commodity of common interest could pool their resources together and co-operate in research and animal-feeding tests. Government regulatory agencies should work with researchers in food irradiation to establish clear-cut protocols for the clearance of irradiation treatment as a food-processing technique rather than as a food additive. The fruit and vegetable-growing industries should show interest in this preservation technique and be willing to work with the research institutions and government agencies. The problems and prospects of using gamma irradiation to disinfest papaya, mango, banana, pineapple, guava and lychee and to extend the shelf-life of papaya and ginger are discussed. (auth)

24409 RADURIZATION AND RADICIDATION OF SPICES. Farkas, J. (Central Food Research Inst., Budapest). pp 43-59 of Aspects of the Introduction of Food Irradiation in Developing Countries. Vienna; International Atomic Energy Agency (1973).

From panel to consider the application of food irradiation in developing countries; Bombay, India (18 Nov 1972). See STI/PUB-362; CONF-721153-.

The importance of spices in world trade, with special reference to the role played by developing countries in producing and marketing them, is proved statistically. The advantages and disadvantages of the use of seasoning extracts and natural spices in the canning and meat-processing industries are compared. Microbial contamination of spices and problems arising from their use are discussed. Fumigation as a means of reducing contamination and problems connected with chemical treatment are surveyed. Results achieved in reducing the cell count in spices with irradiation are given. It is shown that irradiation is the best method of decontamination. The microbiological stability of radiation-treated ground paprika was found satisfactory even at high humidity levels. In relevant experiments the heat treatment requirement of pork liver paste prepared with irradiated ground rice and mixed spices was found to be about one sixth that of pork liver paste prepared with untreated ingredients. The heat and salt sensitivity (water activity requirement) of the microbial flora surviving radiation treatment of 0.3 Mrad was found to be higher than that of the untreated microflora of spices. A radiation dose of 0.4 to 0.5 Mrad proved sufficient to reduce the cell count to the level required in the meat and canning industries. Finally, the economic aspects and authorization from the point of view of wholesomeness of irradiation are discussed. (auth)

24410 PROSPECTS FOR RADIATION PRESERVATION OF FOOD IN BANGLADESH. Faizur Rahman, A. T. M. (Atomic Energy Centre, Dacca, Bangladesh). pp 61-70 of Aspects of the Introduction of Food Irradiation in Developing Countries. Vienna; International Atomic Energy Agency (1973).

From panel to consider the application of food irradiation in developing countries; Bombay, India (18 Nov 1972). See STI/PUB-362; CONF-721153-.

In view of the promising results obtained in laboratory experiments, the possibility of practical implementation of radiation preservation of various food items was examined and the cost economics assessed. At the moment there is an acute need for proper storage systems for grain preservation. The silo system coupled with radiation source offers a promising possibility for grain storage. Potatoes are now being preserved in cold storage at a very high cost. The total cold storage capacity is also far lower than that needed for the preservation of table potatoes. Onions are not being preserved at all because the costs are 30% higher than for potatoes and storage space is limited. Irradiation followed by storage at from 55 to 60°F could serve as an excellent method for the preservation of table potatoes and onions at about half the cost of cold-storage preservation. The present method of fish marketing involves icing, which is not very satisfactory. Radiopasteurization prior to marketing could greatly improve the quality of fish arriving at the markets. The marketability of the two principal fruits, mango and pineapple, is limited by their high perishability. Radiation-induced ripening delay could significantly improve their marketability. The cost of radiation processing in all the above instances seems quite acceptable. (auth)

24411 PROSPECT OF APPLYING FOOD IRRADIATION IN INDONESIA. Abdullah, N.; Hoedaya, M. S. (National Atomic Energy Agency, Djakarta, Indonesia). pp 71-77 of Aspects of the Introduction of Food Irradiation in Developing Countries. Vienna; International Atomic Energy Agency (1973).

From panel to consider the application of food irradiation in developing countries; Bombay, India (18 Nov 1972). See STI/PUB-362; CONF-721153-.

While ionizing radiation could be successfully applied in the field of food preservation to reduce food losses and offers certain advantages not attained with other preservation techniques, there are still many aspects to be investigated in various food items. Some laboratory studies have been conducted in Indonesia on rice disinfestation and radiopasteurization of seafish. Several aspects have been investigated, but there are still many aspects left for further investigation based on the present status of the rice and fish problems facing the country. Our research center is not in the position to conduct wholesomeness studies now or in the near future. Since preservation of food by irradiation is still a new technique for some developing countries, where well-trained people are limited and sophisticated equipment is lacking, a co-ordinated research program to study certain aspects of food irradiation in the near future is suggested. The co-operation of developing countries in wholesomeness studies should be especially considered, with the hope that certain developing countries that already have proper facilities to conduct research on certain aspects of irradiated footstuffs will open the door wide to other countries that are interested in carrying out such research in the near future. (auth)

24412 FOOD STORAGE PROBLEMS AND FOOD IRRADIATION IN NIGERIA. Adesuyi, S. A. (Nigerian Stored Products Research Inst., Ibadan, Nigeria). pp 79-82 of Aspects of the Introduction of Food Irradiation in Developing Countries. Vienna; International Atomic Energy Agency (1973).

From panel to consider the application of food irradiation in developing countries; Bombay, India (18 Nov 1972). See STI/PUB-362; CONF-721153-.

Data on the magnitude of the problem of food storage in Nigeria are presented and the potentialities of the application of food irradiation in a developing country shown. (auth)

24413 PUBLIC HEALTH AND LEGAL PROBLEMS OF FOOD IRRADIATION. Matsuyama, A. (Inst. of Physical and Chemical Research, Wako-shi, Japan). pp 83-86 of Aspects of the Introduction of Food Irradiation in Developing Countries. Vienna; International Atomic Energy Agency (1973).

From panel to consider the application of food irradiation in developing countries; Bombay, India (18 Nov 1972). See STI/PUB-362; CONF-721153-.

Problems and difficulties on clearance and legislation of irradiated food with regard to the public health aspects are discussed. In connection with the international trade it is stressed that legislation, clearance specifications and technical recommendations for common items of irradiated food must be considered at both the international and the national levels. (auth)

24414 STRATEGIES FOR THE INTRODUCTION OF FOOD IRRADIATION IN A DEVELOPING COUNTRY. Sreenivasan, A. (Bhabha Atomic Research Centre, Trombay). pp 87-108 of Aspects of the Introduction of Food Irradiation in Developing Countries. Vienna; International Atomic Energy Agency (1973).

From panel to consider the application of food irradiation in developing countries; Bombay, India (18 Nov 1972). See STI/PUB-362; CONF-721153-.

A vast amount of research work during the past two decades has established the technical feasibility of food irradiation and its advantages over other methods of preservation. Inadequacy or absence of other methods of preserving food and the prevalence of poor harvesting, storage, transportation and retailing practices make the need and the scope for the application of this technology especially important in the developing regions of the world. These, together with climatic, economic, nutritional, public health and other underlying considerations, which favor the adoption of food irradiation in these countries, have been analyzed. The research and development work in food irradiation in India and the strategic considerations involved in these efforts are briefly reviewed. In spite of the obvious benefits of the process, there has as yet been no large-scale application at commercial level. Tracing the origin and the nature of the problem of wholesomeness evaluation of irradiated foods, which has posed a major hindrance to progress, the need for a realistic approach to safety evaluation has been stressed. To achieve any significant success in the widespread use of this technology, collaborative approaches at the international level are essential, both with respect to evolving practicable methods of wholesomeness testing and for ensuring uniformity in regulatory and legislative procedures. (auth)

24415 GAS INJECTION WITH RADIOACTIVE TRACER TO DETERMINE RESERVOIR CONTINUITY: EAST COALINGA FIELD, CALIFORNIA. Tinker, G. E. J. Petrol. Technol.; 25: 1251-1254(Nov 1973).

Radioactive tracers injected with natural gas revealed that desaturated intervals were often continuous over wide areas of the field; those intervals could greatly influence an injection project by acting as thief zones for injected water. The tracer study suggested generally better reservoir sand continuity than could be inferred from a related outcrop study. (auth)

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 24052, 24472, and 26506.

24416 (INIS-mf-728) EFFECT OF ^{60}Co GAMMA IRRADIATION ON THE ISOENZYMIC SPECTRUM OF LACTA-DEHYDROGENASE (LDH) DURING THE EMBRYONAL DEVELOPMENT OF CHICKENS. Todorov, B.; Georgiev, P.; Dryanovski, P. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 15p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

The dynamics of appearance and disappearance of the isoenzymes of lactate-dehydrogenase (LDH) during the embryonal development of the chickens were studied. Depending on the age of the embryos 2 to 4 anode and one cathode isoenzyme (LDH_5) are determined. On the 12th day after the beginning of the incubation the activity of the anode isoenzyme decreases rapidly and the activity of LDH_5 increases. During the first days after hatching LDH_5 is retained only in the liver and the muscles. In front of the most fast moving anode isoenzyme appear additional poles, which disappear after the 15th day of the embryonic development. At irradiation with 1000 rad of 6-day-old embryos a third anode isoenzyme appears in the 6th hour after irradiation and in the 72nd hour in the brain of chickens irradiated with 3 rad and in the skeletal muscles of chickens irradiated with 1000 rad the cathode isoenzyme (LDH_5) is clearly differentiated. In 21-day-old embryos irradiated with 1000 rad in the 24th hour after irradiation in the liver appears LDH_5 which is absent in the controls and in embryos irradiated with 3 rad. In the blood serum of irradiated 21-day-old embryos strongly increased activity of the most active enzyme is observed which diminishes significantly in the 24th hour after the irradiation while the activity of the cathode isoenzyme (LDH_5) increases in the later hours after irradiation as well. This is most strongly expressed in embryos irradiated with 3 rad. The results obtained show that the radiosensitivity of the embryos is not constant and undergoes fluctuation in the process of the embryogenesis. Most significant changes in the isoenzymic spectrum are observed in the period of the organ formation, i.e. in the moment of the most intensive cellular differentiation. (auth)

24417 (INIS-mf-729) EFFECT OF ^{60}Co GAMMA RADIATION ON THE ISOENZYMES OF THE NONSPECIFIC ESTERASES IN THE EMBRYONIC DEVELOPMENT OF CHICKENS. Todorov, B.; Georgiev, P.; Dryanovski, P. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 10p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

The isoenzymes of non-specific esterases in the heart, muscles, liver, and brain of chicken embryos are represented by 7 isoenzymes. According to their electrophoretic mobility compared with that of the protein fractions of the human serum they are distributed by one in the region of the β-globulins, the albumins, and postalbumins, and by 2 to 4 in the region of the prealbumins. In the early stages of the embryonal development the isoenzymes disappear from the region of the β-globulins after irradiation with a dose of 1 K rad. The chicken embryo is particularly sensitive to gamma radiation during the period between the 9th and 13th day from their development. It is ascertained that in many cases irradiation with 3 rad stimulates the activity of the esterases while in almost all cases a dose of 1 Krad inhibits that activity. (auth)

24418 MOLECULAR ASPECTS OF GENETIC RECOMBINATION AND THEIR RELEVANCE TO CUTANEOUS BIOLOGY. Carter, D. M. (Yale Univ. School of Medicine, New Haven). J. Invest. Dermatol.; 60: 369-373(Jun 1973).

Genetic recombination is reviewed with regard to: DNA structure; breaking and rejoining versus copy choice; hybrid overlap and synapsis; enzymes for breaking and joining; the recombination enzymes of phage lambda; and cutaneous events requiring breaking and rejoining of DNA. The lack of endonucleolytic activity required for excision of UV-induced pyrimidine dimers in DNA of patients with xeroderma pigmentosum is discussed in relation to the repair of UV-induced injuries to DNA. (HLW)

24419 RADIATION REACTION OF THE NAD^+– NADH SYSTEMS IN VITRO AND IN MITOCHONDRIA AS A FUNCTION OF THE METABOLIC STAGE. Ojeda-Schwencke, F. Giessen, Ger.; Univ. Giessen (1972). 82p. (In German).

Thesis.

The methods and results of investigations on the influence of the metabolic state on the effect of 150 kV x rays and ^{60}Co gamma rays on the system NAD^+–NADH in rat liver mitochondria are described. Irradiation with 2.7 krad already clearly affected the reduction of the pyridine nucleotides in substrate-depleted mitochondria with addition of BOH and the respiratory process itself. The development of the radiation damage depends on the incubation conditions after irradiation, with BOH having a protective effect. The general redox condition seems to be of importance in this case for the radiation reaction of the mitochondria. The release of NAD from the mitochondria proved to be the principal cause of the inhibition of BOH respiration. Experiments on the radiochemical reactions of NADH in pure water and in solutions with orthophosphate buffer have shown that the phosphate ions or/and the radicals play an important role in the radiation-induced reactions. The presence of cysteine in N_2-atmosphere enhances the radiation effect on NADH both in buffered and in purely aqueous solutions. The results of these experiments agree well with the hypothesis set up by Bacq and Alexander that says that the physiological condition of the cells is a major factor determining the radiation reaction of the cells. (GE)

24420 EFFECT OF PHOTOREACTIVATION ON THE FILLING OF GAPS IN DEOXYRIBONUCLEIC ACID SYNTHESIZED AFTER EXPOSURE OF ESCHERICHIA COLI TO ULTRAVIOLET LIGHT. Bridges, B. A.; Sedgwick, S. G. (Univ. of Sussex, Brighton, Eng.). J. Bacteriol.; 117: No. 3, 1077-1081(Mar 1974).

Daughter-strand gaps in deoxyribonucleic acid (DNA) synthesized after exposure of excision-deficient Escherichia coli to ultraviolet light are filled during subsequent incubation in buffer, and the rate of filling is increased when the incubation in buffer is carried out in the presence of 360-nm light. It was concluded that daughter-strand discontinuities are prevented from being rapidly sealed in the dark not because of some structural feature of the daughter-strand but because of the presence of a pyrimidine dimer on the opposite (parental) strand. Photoreactivation-stimulated gap filling is dependent on the $polA^+$ and $recA^+$ but not the $exrA^+$ genes. It is suggested that removal of the dimer allows gap-filling by DNA polymerase I and polynucleotide ligase. The $recA^+$ gene may be needed at a very early stage, possibly for gap stabilization. (auth)

24421 COMBINED ACTION OF UV-IRRADIATION, TEMPERATURE, AND SODIUM DITHIONITE ON SPECTRAL CHARACTERISTICS OF HEMOGLOBIN. Artyukhov, V. G.; Shmelev, V. P.; Dul'chenko, L. G. (Voronezh State Univ., USSR). Biol. Nauki; No. 1, 47-50(Jan 1973). (In Russian).

The electron absorption spectra of aqueous solutions of hemoglobin of cattle after subjecting it to uv irradiation from a PRK-2 light were recorded. The irradiation of the hemoglobin solution to doses of 2.36×10^5 erg/cm^2 caused a substantial decrease of the optical density in the Soret band and displacement of its position in the long-wave area of the spectrum. By modification of the sodium dithionite of the irradiated solution of the hemoglobin the formation of intermediate reduction products was observed. Significant differences were detected in the values of the absorption in the Soret band of irradiated and incubated solutions after irradiation of the hemoglobin solutions. (tr-auth)

24422 ULTRAVIOLET INDUCED INTERACTIONS OF SALICYLANILIDES AND OTHER PHOTOSENSITIZERS WITH MONOMOLECULAR FILMS. Chawdry, I. M. New Brunswick, NJ; Rutgers– The State Univ. (1973). 129p. University Microfilms Order No. 73-27,904.

Thesis (Ph.D.).

Monomolecular films of cholesterol, phospholipids, proteins and mixed phospholipid-protein were used as a simulated biological model to study the effect of salicylanilides and other photosensitizing drugs. Films were spread on a phosphate buffer subphase in the presence and absence of photosensitizing drugs and exposed to ultraviolet irradiation for 15 minutes. No change was observed following ultraviolet irradiation of egg lecithin, dipalmitoyl lecithin and albumin monolayers in the absence of drugs. A slight expansion of cholesterol monolayers occurred due to the formation of 7-α-hydroxy cholesterol and 7-keto cholesterol. This reaction obeyed a zero order kinetics. The π-A curves of cholesterol films showed significant expansion on exposure to ultraviolet irradiation with 3,4',5 tribromosalicylanilide in the subphase ($\Delta A = 57A^2$). Irradiation of cholesterol films in the presence of

3,3′,4′5 tetra-chlorosalicylanilide and bithionol lead to similar results ($\Delta A = 55A^2$). Hexachlorophene showed a much smaller effect ($\Delta A = 30A^2$). Similar results were obtained on irradiation of phospholipids in the presence of 3,4′,5 tribromosalicylanilide in the subphase. Data suggest, that while a free radical may result on exposure of the halogenated salicylanilides to ultraviolet irradiation, the radical does not react directly with the film, but rather forms a surface active photoproduct. (DHM)

Radiation Effects on Cells

Refer also to abstracts 24449, 24482, 24488, and 26510.

24423 EFFECT OF HYPOXIA ON SYNCHRONOUS HeLa CELLS IRRADIATED WITH FAST NEUTRONS. Sapozink, M. D.; Djordjevic, B. (Sloan-Kettering Inst. for Cancer Research, New York). Radiology; 110: No. 3, 691-698(Mar 1974).

HeLa cells were made hypoxic by co-incubation with an excess of heavily irradiated feeder cells. Hypoxic and oxygenated cells (without feeder cells) were irradiated with cyclotron-produced fast neutrons in three different parts of the division cycle. Oxygen enhancement ratios (OER) varied between 1.51 and 1.74 in cells irradiated 1.5 hours after mitosis and fell within this range in cells irradiated 7.5 hours post-initiation (9% cells labeled with tritiated thymidine) and in cells irradiated 13.5 hours post-initiation of the culture (90% cells labeled). It was concluded that no significant change in OER occurred during the division cycle. (auth)

24424 RBE AND OER DETERMINATIONS FOR RADIUM AND CALIFORNIUM-252. Hall, E. J.; Phil, D.; Roizin-Towle, L. A.; Colvett, R. D. (Columbia Univ., New York). Radiology; 110: No. 3, 699-704(Mar 1974).

Chinese hamster cells cultured in vitro were used to compare ^{226}Ra γ rays (dose rate, 50 rads/hour) with the mixed fast neutron/γ-ray emission from ^{252}Cf (dose rate, 18 rads/hour). The relative biological effectiveness (RBE) of ^{252}Cf neutrons compared with radium γ rays was 5.9. The oxygen enhancement ratios (OER) for ^{226}Ra and ^{252}Ca were found to be 2.0 and 1.42, respectively. The implications for radiotherapy are discussed. (auth)

24425 RECOVERY OF THE ABILITY TO SYNTHESIZE DNA IN SEGMENTS OF NORMAL SIZE AT LONG TIMES AFTER ULTRAVIOLET IRRADIATION OF HUMAN CELLS. Buhl, S. N.; Setlow, R. B.; Regan, J. D. (Univ. of Tennessee, Oak Ridge). Biophys. J.; 13: No. 12, 1265-1275(Dec 1973).

DNA synthesized in human cells within the first hour after ultraviolet (UV) irradiation is made in segments of lower molecular weight than in nonirradiated cells. The size of these segments approximates the average distance between pyrimidine dimers in the parental DNA. This suggests that the dimers interrupt normal DNA synthesis and result in gaps in the newly synthesized DNA. However, DNA synthesized in human cells at long times after irradiation is made in segments equal or nearly equal to those synthesized by nonirradiated cells. The recovery of the ability to synthesize DNA in segments of normal size occurs in normal human cells, where the dimers are excised, and also in cells of the human mutants xeroderma pigmentosum (XP), where the dimers remain in the DNA. This observation implies that the pyrimidine dimer may not be the lesion that causes DNA to be synthesized in smaller than normal segments. (auth)

24426 PROTEIN SYNTHESIS IN GIANT CELLS INDUCED BY X IRRADIATION. Megumi, T.; Hosokawa, Y. (Radiation Center of Osaka Prefecture, Sakai, Japan). Annu. Rep. Radiat. Center Osaka Prefect.; 13: 124-127(Mar 1973).

L cells became giant without cell division after x irradiation with 5000 R and some of them reached 200 times volume of an unirradiated cell. Protein of giant cells was analyzed electrophoretically after treatment with SDS and urea. Electrophoresis of whole polypeptides of giant cells labeled with ^{3}H-leucine and unirradiated cells labeled with ^{14}C-leucine was performed in 3% of acrylamide gel. The electrophoretic pattern showed 13 bands at least. Incorporation of ^{3}H-leucine in giant cells was remarkably less than that of ^{14}C-leucine in unirradiated cells in band 6, 9, 10, and 11. Relationship with abnormality of protein synthesis, damage of cell division, and giant cell formation was discussed. (auth)

24427 CHEMICAL RADIOSENSITIZATION OF ANOXIC MAMMALIAN CELLS: EFFECT OF CELL CONCENTRATION. Agnew, D. A.; Skarsgard, L. D. (Univ. of British Columbia, Vancouver). Radiat. Res.; 57: No. 2, 246-259(Feb 1974).

The effect of several electron affinic compounds on the radiation response of Chinese hamster cells irradiated in both dilute cell suspension and centrifugation pellets was investigated. p-Nitroacetophenone (500 μM), 175 μM nitrofurazone, and 200 μM dimethyl fumarate, when present during the irradiation of anoxic, dilute cell suspensions, produced dose-modifying factors of 1.5, 1.8, and 1.8, respectively. Anoxic cells irradiated at high cell concentrations and in the presence of a sensitizer experienced a two-stage loss of much of the sensitization normally seen in dilute cell suspension. A large component of sensitization was lost upon formation of the cell pellet, reducing the dose modifying factors to values approximately 70% of those obtained in dilute cell suspensions. This was followed by a slow disappearance of the remaining component of sensitization. Some possible mechanisms for this cell concentration effect are discussed. It is suggested that the cell pellet experiment may prove to be a useful indicator of the effectiveness of radiosensitizers in vivo. (auth)

24428 INTERFERON INDUCTION IN RABBIT CELLS IRRADIATED WITH UV LIGHT. Mozes, L. W.; Vilcek, J. (New York Univ., NY). J. Virol.; 13: No. 3, 646-651(Mar 1974).

UV irradiation of a continuous line of rabbit kidney cells (RK13) was used as a tool for the study of the mechanism of interferon induction. Irradiation of cells prior to their exposure to Newcastle disease virus (NDV) resulted in a dose-dependent decrease in interferon production. The inhibition of total cellular RNA synthesis by uv irradiation in uninduced cultures was similar to the inactivation curve of interferon production in NDV-induced cultures. In contrast, the production of interferon with polyinosinate-polycytidylate (poly[I] · poly [C]) paradoxically was enhanced in cells irradiated with a wide range of doses of uv. However, in cells stimulated with poly(I) · poly(C) and superinduced by the sequential addition of cycloheximide and actinomycin D, the rate of inactivation of interferon production by uv light was similar to that observed with NDV. These results are not inconsistent with the idea that both poly(I) · poly(C) and NDV stimulate the same interferon gene(s), but indicate that the mechanism controlling its expression may be different for each inducer. (auth)

24429 DOSE-RESPONSE RELATION OF CHROMOSOME ABERRATIONS IN HUMAN LYMPHOCYTES AFTER IN VITRO IRRADIATION WITH 3-MeV ELECTRONS. Schmid, E.; Rimpl, G.; Bauchinger, M. (Univ., Munich). Radiat. Res.; 57: No. 2, 228-238(Feb 1974).

Human peripheral lymphocytes were irradiated with different doses of 3-MeV electrons. The dosimetry was performed according to Fricke. The frequency of different aberration types was determined and the dose-response relation was calculated. The data were fitted by least-squares regression analysis to different models. The dicentric, dicentric + centric ring, and different acentric data gave the best fit to the linear quadratic model. The RBE of 3-MeV electrons compared with 220-kV x rays increases with increasing dose. (auth)

24430 SEDIMENTATION OF DNA FROM HUMAN FIBROBLASTS IRRADIATED WITH ULTRAVIOLET LIGHT: POSSIBLE DETECTION OF EXCISION BREAKS IN NORMAL AND REPAIR-DEFICIENT XERODERMA PIGMENTOSUM CELLS. Cleaver, J. E. (Univ. of California, San Francisco). Radiat. Res.; 57: No. 2, 207-227(Feb 1974).

Usual alkaline sucrose techniques, which produce single-stranded DNA from unirradiated mammalian cells of $2-5 \times 10^8$ daltons (120-165 S) prove inadequate for resolution of strand breaks transiently present during excision repair of ultraviolet (uv) damage. These breaks seem to be relatively few in number and sedimentation changes are at the limit of resolution. Using a simple modification employing brief lysis in alkali, DNA with sedimentation coefficients up to 350 S have been obtained from human fibroblasts. 350-S DNA from unirradiated fibroblasts consists of complementary strands cosedimenting with choline-labeled material originating in the cytoplasm, in a conformation that allows renaturation to double-stranded DNA on neutralization after gradient fractionation. Large changes in sedimentation coefficient occur immediately after irradiation of normal fibroblasts with doses as low as 5–10 ergs/mm^2, but not xeroderma pigmentosum (XP) fibroblasts. The kinetics of the uv-induced changes in sedimentation of DNA from normal fibroblasts are consistent with the hypothesis that they are caused by strand breaks associated with excision repair that act as sites for strand separation in alkali. At various times after irradiation, strand breaks accumulate in DNA from XP (deSanctis-Cacchione) fibroblasts, suggesting either that these cells may possess uv-specific endonucleolytic activity but lack a later stage in repair or that breaks accumulate during cell death by action of nucleases which may be different from repair enzymes. (auth)

24431 DIRECT OBSERVATION OF THE REPRODUCTION OF IRRADIATED MAMMALIAN CELLS IN VITRO BY MEANS OF TIME-LAPSE MICROCINEMATOGRAPHY. Trott, K. R. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Nuremburg). Naturwiss. Rundsch.; 26: No. 11, 473-474(Nov 1973). (In German).

The formation of a cell colony and the effect of irradiation upon it were observed using time-lapse microcinematography, so as to determine the reproductive behavior. Mice fibroblasts were used for the experiment. Cell division could be recorded in the form of a genealogical table. Some irradiated cells tended to stop their reproduction, keeping on, however, their metabolic activity. This disturbance of the reproduction is the aim of the radiation therapy in the treatment of malignant tumors. Irradiation with doses of less than 500 R of x radiation did not cause new forms of cell damage, but the radiation-induced reproduction deficients were not so randomly distributed in the genealogical table as the spontaneously generated. The increase of division failure was limited to a few generations in the case of acute irradiation. (GE)

Radiation Effects on Microorganisms

Refer also to abstracts 24401, 24404, 24406, 24408–24412, and 24472.

24432 (INIS-mf-727) EFFECT OF GAMMA RAYS ON THE PROPAGATION OF VIRUS AUESKI. Dilovski, M. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 9p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

The effect of gamma rays from ^{60}Co in a dose of 5.10^5 R on the propagation of virus Aueski in tissue cultures from chicken fibroblasts was investigated. The synthesis of the virus DNA was investigated autoradiographically, the virus protein by means of immunofluorescence, and of the formation of infectious virus by determining the infectious titre. Gamma irradiation damages selectively the DNA without affecting the synthesis of the virus protein and thus inhibits the formation of infectious virus particles. The synthesis of the virus DNA is reduced in infected cells treated with gamma rays by about 50% as compared to the control not treated but infected with virus cells. L. cysteine reduces the inhibiting effect of gamma rays if applied simultaneously with the gamma irradiation. (auth)

24433 (INIS-mf-731) RADIOSENSITIVITY OF STR. FAECALIS IN THE PRESENCE OF CERTAIN CHEMICAL SUBSTANCES ($NaNO_3$ AND $NaNO_2$) AT CONCENTRATIONS CONTAINED IN THE MEAT PRODUCTS. Stojchev, M.; Brankova, R. N.; Dzhedzheva, D. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 11p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Investigations were carried out on the radiosensitivity of Streptococcus faecalis cells in suspension of 2.5×10^8 in ml density, irradiated with 20, 30, 40, and 50 K rad gamma rays in the presence of $NaNO_3$ (0.025, 0.08, and 0.25%) and $NaNO_2$ (0.125 and 0.0125%). Changes in the number of the cells were observed immediately after irradiation as well as after 24, 48, 72, and 96 hours. It was established that Str. faecalis sensitivity to irradiation was higher in the presence of $NaNO_2$ and $NaNO_3$ than in physiological solution. The post-irradiation effect of dying off is more faintly expressed at irradiation in the presence of $NaNO_3$. The investigations carried out are of theoretical and practical importance in connection with the elaboration of combined methods for pasteurization with ionizing irradiation of canned meat. (auth)

24434 THERMAL REACTIVATION OF ULTRAVIOLET-IRRADIATED ESCHERICHIA COLI. Relationship to Respiration. Swenson, P. A.; Boyle, J. M.; Schenley, R. L. (Oak Ridge National Lab., TN). Photochem. Photobiol.; 19: No. 1, 1-7(Jan 1974).

The effects of postirradiation incubation at 42°C on respiration and viability were studied in cells of ultraviolet (uv)-irradiated Escherichia coli strains B/r and B. Prior to uv irradiation ($52J/m^2$ at 254 nm), the cells were grown in minimal liquid medium containing glycerol. When incubated in this liquid medium at 37°C, respiration of both strains was known to cease about an hour after uv irradiation, but was found to be continuous on incubation at 42°C. In both strains, continuance of respiration was accompanied by an early increase in viability (liquid thermal reactivation), but the increase for B/r (30-fold) was 3 times that for strain B. The kinetic pattern of viability for B/r at 42°C was the same as that previously obtained for B/r and B when respiration was maintained by 5-fluorouracil (FU) treatment. A different pattern was seen for strain B at 42°C, but when FU and thermal treatments were given together, the FU type response dominated and the amount of reactivation obtained was about the same as with FU alone. It is suggested that in the absence of FU, liquid thermal treatment prevented division of a potentially reactivable group of filaments in the lon^- strain. The amount of liquid thermal reactivation (where plates were incubated at 37°C) was about equal to the amount of plate thermal reactivation (where irradiated cells, plated immediately after uv irradiation were incubated at 42°C). It is inferred that liquid and plate thermal reactivation involves the same group of cells. (auth)

24435 CELLULAR REACTIVATION OF ULTRAVIOLET-IRRADIATED HUMAN ADENOVIRUS 2 IN NORMAL AND XERODERMA PIGMENTOSUM FIBROBLASTS. Day, R. S. (National Cancer Inst., Bethesda, MD). Photochem. Photobiol.; 19: No. 1, 9-13(Jan 1974).

A plaque assay for adenovirus 2 on normal human fibroblasts was developed and used to measure the survival of ultraviolet-irradiated virus on six human fibroblast cell lines. When four xeroderma pigmentosum cell lines were used as viral hosts, an average of one lethal event per virus in the viral population was made with 10, 15, 62, and 78 Jm^{-2} respectively, while using two normal cell lines as hosts, 197 and 205 Jm^{-2} were required to inflict the same damage. These differences are attributed to the known repair deficiency of xeroderma pigmentosum cells, and are discussed in the light of previous data obtained using other animal viruses. (auth)

24436 IONIZIRUYUSHCHIE IZLUCHENIYA V KOZHEVENNOI PROMYSHLENNOSTI. (Ionizing Radiation in the Leather Industry). Strakhov, I. P.; Levenko, P. I.; Shifrin, I. G. (Moscow; Legkaya Industriya (1973). 159p.

The forms of ionizing radiation, the basic types of irradiation installations, and processes occurring under the influence of ionizing radiation in amino acids, protein, enzymes, hides, and different forms of leather are described. The effect of radiation on basic proteins of hides and furs—collagen and keratin—is examined in detail. Processes of sterilization and disinfecting of hides by ionizing radiation are discussed. The optimum radiation doses are recommended. The protection of biological objects from radiation is considered. (tr-auth)

24437 REPAIR OF SINGLE-STRAND BREAKS IN A RADIOSENSITIVE MUTANT OF MICROCOCCUS RADIODURANS. Ponura, T.; Bruce, A. K. (State Univ. of New York, Buffalo). Radiat. Res.; 57: No. 2, 260-275(Feb 1974).

The kinetics of x-ray-induced single-strand break rejoining have been studied in wild-type M. radiodurans and a radiosensitive mutant, UV17. The initial fast rejoining reaction observed in wild-type cells in growth medium was absent in UV17. Studies in which irradiated cells were allowed to repair under various conditions confirm that a buffer-mediated rejoining system is absent in UV17 while rejoining of strand breaks under growth conditions is slower but not absent. DNA breakdown is more extensive in UV17 although its rate is similar to that of the wild-type. In both strains the x-ray-induced DNA synthesis delay and the time for maximal release of acid-soluble material correlate. In vitro studies show the capacity of lysates of wild-type and mutant cells to catalyze the incorporation of deoxyribonucleotide triphosphates into acid-insoluble material are similar while DNase activity in the mutant is much greater than in the wild type. The in vitro data are correlated with the in vivo observations and indicate that the sensitivity of UV17 to ionizing radiation may be the result of an inhibition of DNA polymerase-mediated repair and not a consequence of an exr or lex type of mutation as has been previously thought. (auth)

24438 H_2O AND D_2O SORPTION STUDIES ON SPORES OF BACILLUS MEGATERIUM. Tallentire, A.; Hayes, J. R.; Kimler, B. F.; Powers, E. L. (Univ. of Manchester, Eng.). Radiat. Res.; 57: No. 2, 300-305(Feb 1974).

H_2O and D_2O sorption isotherms were obtained for air-dried and freeze-dried preparations of Bacillus megaterium spores using drying and equilibration techniques that resembled closely those employed in radiation experiments reported extensively with this organism. No significant difference exists between values of "apparent monolayer capacities" for spores prepared in these two ways and, at low values of P/P_0, between the adsorbed amounts, in molar terms, of the two kinds of water. For H_2O adsorption, the numbers of water molecules/DNA phosphate at "monolayer capacity" and at saturation vapor pressure are calculated to be 1.2 and 4.5, respectively. These values can be related to radiation sensitivity of the spore. (auth)

24439 EFFECT OF ULTRAVIOLET LIGHT ON MENGOVIRUS: FORMATION OF URACIL DIMERS, INSTABILITY AND DEGRADATION OF CAPSID, AND COVALENT LINKAGE OF PROTEIN TO VIRAL RNA. Miller, R. L.; Plagemann, P. G. W. (Univ. of Minnesota, Minneapolis). J. Virol.; 13: No. 3, 729-739(Mar 1974).

UV irradiation of purified mengovirus resulted in a very rapid inactivation of the infectivity of the virions (D_{37} [37% survival dose] = 700 ergs/mm^2) which correlated in time with the formation of uracil dimers in the viral RNA. During the first 2 min of irradiation, an average of 1.7 uracil dimers were formed per PFU of virus inactivated. Hemagglutination activity of the virions began to decrease only after a lag period of about 5 min and at a much lower rate (D_{37} = 84,000 ergs/mm^2). This decrease coincided in time with the appearance of altered proteins in the capsid and a structural change in the capsid. Although 10- to 20-min irradiated virions appeared intact in the electron microscope and sedimented at 150S in sucrose density gradients, the RNA of the virions became accessible to RNase and extractable by low concentrations of sodium dodecyl sulfate, and the virions broke down upon equilibrium centrifugation in CsCl gradients. During longer periods of irradiation (30 to 60 min), a progressively greater proportion of the virions were converted to 14S protein particles and 80S ribonucleoprotein particles composed of intact viral RNA and about 30% of the capsid proteins, alpha, beta, and gamma. Empty capsids were not detectable at any time during 60 min of irradiation, by which time disruption of the virions was complete. Irradiation of complete virions also resulted in an increased sedimentation rate of the viral RNA and in the covalent linkage to the viral RNA of about 1% of the total capsid protein in the form of heterogeneous low-molecular-weight polypeptides. The two observations seem to be causally related, since irradiation of isolated viral RNA did not result in an increase in sedimentation rate of the RNA, even though uracil dimer formation in viral RNA occurred at about the same rate and to the same extent whether intact virions or viral RNA were irradiated. (auth)

24440 IN VITRO REPAIR OF UV-IRRADIATED MICROCOCCUS LUTEUS BACTERIOPHAGE N1 TRANSFECTING DNA. Mahler, I.; George, J.; Grossman, L. (Brandeis Univ., Waltham, MA). J. Virol.; 13: No. 3, 765-767(Mar 1974).

Calcium-treated uv-sensitive, host cell reactivation⁻ strains of Micrococcus luteus are infected with uv-irradiated N1 DNA. In strains lacking uv endonuclease, in vitro treatment of the irradiated DNA results in transfection enhancement. (auth)

24441 GENE EXPRESSION DURING THE DEVELOPMENT OF BACTERIOPHAGE ϕ29. III. Analysis of Viral-Specific Protein Synthesis with Suppressible Mutants. McGuire, J. C.; Pene, J. J.; Barrow-Carraway, J. (Univ. of Delaware, Newark). J. Virol.; 13: No. 3, 690-698(Mar 1974).

Fifty-four suppressible mutants of bacteriophage ϕ29 have been isolated with a variety of mutagens and assigned to eight complementation groups. Viral-specific protein synthesis in uv light-irradiated, nonsuppressing Bacillus subtilis 60084 was analyzed with exponential acrylamide gels. Four additional ϕ29 proteins which were undetected on ordinary acrylamide gels are reported in this paper. Five phage ϕ29 proteins have been unambiguously assigned to specific cistrons. Two cistrons had pleiotropic effects on viral protein synthesis. Mutants in cistrons I or II were unable to synthesize DNA in nonsuppressing bacteria. Mutants in cistron I were unable to attach viral chromosomes to the host cell membrane, and the protein responsible for this function has been identified. The other viral protein playing a role in phage ϕ29 DNA synthesis is also identified and assigned to cistron II. Mutants in cistron II can attach viral chromosomes to membrane, but cannot synthesize DNA in nonsuppressing bacteria. (auth)

24442 NEAR-UV EFFECTS ON THE INDUCTION OF PROPHAGE. Coetzee, W. F.; Pollard, E. C. (Pennsylvania State Univ., University Park). Radiat. Res.; 57: No. 2, 319-331(Feb 1974).

Effects of near-uv (320 to 400 nm) on the induction of prophage were studied for Escherichia coli K12λ, strains 15 and B. Gamma rays, 254-nm uv, and hydrostatic pressure were used as inducing agents. Prophage induction was assayed by observation of plaque-forming units in K12λ and detection of leakage, as evidenced by release of β-galactosidase from the cells. The results indicate that near-uv effects on lysogenic cells depend on the nature of the inducer. Some evidence that the action of near-uv can be related to modification of the envelope of the cell is presented. (auth)

24443 INFLUENCE OF ADDED H_2O AND D_2O ON ANOXIC RADIATION SENSITIVITY IN BACTERIAL SPORES. Iwasaki, T.; Tallentire, A.; Kimler, B. F.; Powers, E. L. (Univ. of Texas, Austin). Radiat. Res.; 57: No. 2, 306-310(Feb 1974).

With careful control of water vapor pressure for equilibrating dried spores of Bacillus megaterium, changes were measured in the O_2-independent component (k_I) of radiation damage over the narrow range in which water increase causes a rise in the inactivation constant. The measures were made for both H_2O and D_2O as added water. For added H_2O, k_I begins to increase at a water content below and is complete at a content above that which represents a monolayer in the cell (1.2 molecules H_2O/DNA phosphate); for D_2O the behavior is the same but quantitatively different (1.3 molecules D_2O/phosphate). This suggests that sensitization is caused by water radiolysis in a water shell immediately external to the target molecule, and the fact that in D_2O the spores are slightly more sensitive than in H_2O points to the hydroxyl radical as the important species. This supports other studies that indicate that OH species is important in anoxic radiation-induced damage to these cells. (auth)

24444 GAMMA IRRADIATION OF FISHERY PRODUCTS IN THAILAND WITH SPECIAL REFERENCE TO THEIR MICROBIOLOGICAL AND ENTOMOLOGICAL ASPECTS. Loaharanu, P. (Office of Atomic Energy for Peace, Bangkok). pp 21-32 of Aspects of the Introduction of Food Irradiation in Developing Countries. Vienna; International Atomic Energy Agency (1973).

From panel to consider the application of food irradiation in developing countries; Bombay, India (18 Nov 1972). See STI/PUB-362; CONF-721153-.

Gamma irradiation of boiled chub mackerel, a semi-preserved fishery product containing approximately 4% NaCl, at doses of 0.1, 0.2 or 0.3 Mrad extended the storage life of the boiled fish at room temperature by 7, 12 and 14 days, respectively, longer than the non-irradiated control. Shipping and consumer-acceptance studies of the irradiated boiled fish in inland markets in the North and Northeast of Thailand indicated that the irradiation of the boiled fish at 0.2 Mrad would be commercially feasible and caused no objection by the consumers. Irradiation of fresh crab meat and shrimp at 0.15 and 0.25 Mrad revealed that the storage life of the products was significantly extended in refrigerated storage. A relatively large amount of fish meal produced locally contains Salmonella. It was found that a dose of 0.5 Mrad would be sufficient to eliminate Salmonella at natural levels of contamination in the product. A high percentage of fresh marine fish and shellfish caught in Thailand contains Vibrio parahaemolyticus. Several serotypes of this halophilic pathogenic bacterium have been isolated and their radiation resistance determined. The three serotypes of V. parahaemolyticus studied, i.e. K_{20}, K_{28} and an untypable serotype, appeared to have low radiation resistance. Their D_{10} values range from 3 to 16 krad, varying according to serotype and the salt content of the media. About 60 to 70% of commercially salted and dried fishery products in Thailand were found to be infested with flies of six different species. The most prominent species of fly infested salted and dried marine fish appeared to be the cheese skipper, and the prominent one that infested salted and dried freshwater fish was the bronze bottle fly. The radiosensitivity of each species of fly at the different stages is described. (auth)

24445 STUDIES OF SOME MICROBIOLOGICAL AND CHEMICAL ASPECTS OF IRRADIATED SPICES. Bachman, S.; Gieszczynska, J. (Univ. of Lodz, Poland). pp 33-41 of Aspects of the Introduction of Food Irradiation in Developing Countries. Vienna; International Atomic Energy Agency (1973).

From panel to consider the application of food irradiation in developing countries; Bombay, India (18 Nov 1972). See STI/PUB-362; CONF-721153-.

The contamination introduced into the food products by spices are of the order of 10^5 to 10^7 microorganisms per gram, effecting a deterioration of the food. The determination of the total bacterial count of various spices such as: marjoram, caraway, coriander, charlock, cardamom, juniper, paprika, black pepper, pimento and three mixtures of spices that are commonly used in commercial products is discussed. The spices were irradiated in a ^{60}Co gamma source with 0.2 to 2.5 Mrad at a dose rate of 0.5 Mrad/h. The radiation dose required to produce sterility has been found to be 0.75 to 1.0 Mrad (the radiation dose range). Prolonged storage (2 and 6 weeks) enhanced the bactericidal effects, allowing the use of a lower irradiation dose to obtain the same lethal effect. It appears that the flavor of the spices does not change after radappertization doses. A slight modification in chemical composition and an increased yield of volatile oil (marjoram and mixtures) has been observed over the same dose range. (auth)

24446 GAMMA RADIATION INACTIVATION OF COXSACKIEVIRUS B-2. Sullivan, R.; Scarpino, P. V.; Fassolitis, A. C.; Larkin, E. P.; Peeler, J. T. (Food and Drug Administration, Cincinnati). Appl. Microbiol.; 26: No. 1, 14-17(Jul 1973).

The radioresistance of coxsackievirus B-2 was studied when the virus was suspended in Eagle minimal essential medium, distilled water, cooked ground beef, and raw ground beef and irradiated at various temperatures in a cobalt-60 gamma radiation source. The number of surviving viruses at given doses of radiation was determined by a plaque assay system. All destruction curves indicated a first-order reaction. When the virus was irradiated in minimal essential medium at temperatures of –30, –60, and –90°C, D values (in Mrad) were 0.69, 0.59, and 0.64, respectively. When the virus was suspended in water and irradiated at –90°C, the D value was 0.53. Cooked ground beef containing the virus was irradiated at temperatures ranging from 16 to –90°C. The D values were 0.70 (16°C), 0.76 (0.5°C), 0.68 (–30°C), 0.78 (–60°C), and 0.81 (–90°C). Raw ground beef containing the virus was irradiated at –30, –60, and –90°C, and the D values were respectively 0.75, 0.71, and 0.68. The D values indicate that the rate of viral inactivation was dependent on the suspending menstrum. (auth)

24447 INDUCTION OF PROPHAGE IN STREPTOCOCCUS LACTIC C2 BY ULTRAVIOLET IRRADIATION. McKay, L. L.; Baldwin, K. A. (Univ. of Minnesota, St. Paul). Appl. Microbiol.; 25: No. 4, 682-684(Apr 1973).

Streptococcus lactis C2 has been used extensively by many laboratories in studies on the metabolism of lactic streptococci. By using ultraviolet irradiation as the inducing agent, this organism was shown to release a small bacteriophage, indicating that it is a lysogenic strain. The induced phage had a head approximately 40 nm in diameter and a tail length and width of about 180 and 6 nm, respectively. A structure resembling a collar was observed. Attempts to isolate a sensitive indicator strain for the virus were unsuccessful. (auth)

24448 COMPARATIVE RESISTANCE OF NONSPOROGENIC BACTERIA TO LOW-TEMPERATURE GAMMA IRRADIATION. Anellis, A.; Berkowitz, D.; Kemper, D. (Army Natick Labs., MA). Appl. Microbiol.; 25: No. 4, 517-523(Apr 1973).

A total of 36 microorganisms, comprising 19 species of 11 genera, were screened for radiation resistance with ^{60}Co gamma rays at a radiation temperature of -80 ± 2 C in phosphate buffer (pH 7.0) under vacuum. Micrococcus radiodurans was the most resistant organism. An initial population of 2.8×10^5 cells per dose of this species survived 2.4 but not 2.7 Mrad. Of the remaining 18 species with initial populations of about 10^6 cells per dose, Streptococcus faecium survived 0.9 to 1.5 Mrad, depending on the strain tested. S. faecalis QM survived 0.9 but not 1.2 Mrad. S. faecalis 1539 and Alcaligenes faecallis survived 0.6 but not 0.9 Mrad. Three species of Salmonella, one strain each of Escherichia coli, Streptococcus lactis, and Aerobacter aerogenes survived 0.3 but not 0.6 Mrad. The remaining 22 bacteria did not survive 0.3 Mrad, the lowest dose tested. Detailed survival curve determinations for four strains of S. faecium, the most resistant of the test bacteria of public health significance, indicated the following order of resistance at -80 C: $\alpha 21 > \delta 12 = F_6 >$ FEC. Each strain produced two exponential survival curves with different slopes, the breaks occurring at 0.3 to 0.5 Mrad. The D values (doses which reduce the microbial population by 90%) of the more resistant cell fractions were two- to three-fold higher than the more sensitive cell fraction. The resistance of strain $\alpha 21$ was determined at different radiation temperature ($+5, -30, -80, -140, -196$ C). The D value-radiation temperature relationship followed a quadratic equation. Computations of E_a and Q_{10} values (activation energy and temperature coefficient, respectively) showed a very small thermodynamic effect on radiation death. An Arrhenius evaluation of the temperature effect on cell kill indicated that there was no simple physicochemical mechanism which might explain the change in D value as a function of temperature. (auth)

24449 CHLAMYDIA TRACHOMATIS IN CELL CULTURE. I. Comparison of Efficiencies of Infection in Several Chemically Defined Media, at Various pH and Temperature Values, and After Exposure to Diethylaminoethyl-Dextran. Rota, T. R.; Nichols, R. L. (Harvard School of Public Health, Boston). Appl. Microbiol.; 26: No. 4, 560-565(Oct 1973).

Three chemically defined cell culture media, Eagle minimum essential medium (MEM) with Earle basal salt solution, Eagle MEM with Hanks basal salt solution, and a modified Eagle MEM, were tested and found capable of supporting the development of Chlamydia trachomatis in ^{60}Co-treated McCoy cells. The enhancement of trachoma infection by diethylaminoethyl-dextran (DEAE-D) was greater at pH values closer to neutrality than at any other pH values measured at the start of the experiments. Centrifugation of the trachoma inoculum onto cell monolayers at 33 C increased the number of inclusions when compared to centrifugation at 20 C. When the inoculum was centrifuged onto cell monolayers and subsequent incubation was at temperatures ranging from 34 to 39 C, the greatest number of inclusions was observed after incubation from 35 through 37 C. Enhancement of the trachoma infection by DEAE-D was tested at temperatures ranging from 35 to 37 C. These cultures had three- to fivefold increases in inclusions when compared to previously reported experiments in which DEAE-D-treated cultures were incubated at 34 C. (auth)

24450 INTERACTION OF BACTERIAL AND LAMBDA PHAGE RECOMBINATION SYSTEMS IN THE X-RAY SENSITIVITY OF ESCHERICHIA COLI K-12. Trgovcevic, Z.; Rupp, W. D. (Yale Univ., New Haven). Proc. Nat. Acad. Sci. U. S. A.; 71: No. 2, 503-506(Feb 1974).

E. coli cells lysogenic for the thermoinducible prophage λc1857 can be transiently induced by a brief heat treatment. Although this treatment does not kill the cells, some λ products normally formed during vegetative phage development are made that can alter the response of host cells to x irradiation by causing an increase in radioresistance. This increased resistance is particularly striking in the recombination-deficient recB$^-$ strain, which is normally much more radiosensitive than its recB$^+$ parent. After pulse-heating at 42°C, the survival curve of E. coli recB$^-$ lysogenized with λc1857 does not differ from that of the wild-type strain. Since λ red mutants do not increase the radioresistance of recB$^-$ strains, both λ red gene products, λ exonuclease and β-protein, are required to compensate for the missing recB product. Furthermore, phage-induced radioresistance also occurs in recB$^+$ lysogens even when they carry λ red$^-$, but not when the λ prophage is gam$^-$. Thus, in wild-type cells, phage-induced radioresistance requires some interaction between the bacterial recB gene product (exonuclease V) and the phage γ-protein. (auth)

24451 PROTEIN KINASE INDUCTION IN ESCHERICHIA COLI BY BACTERIOPHAGE T7. Rahmsdorf, H. J.; Pai, S. H.; Ponta, H.; Herrlich, P.; Roskoski, R. Jr.; Schweiger, M.; Studier, F. W. (Max-Planck-Institut fuer Molekulare Genetik, Berlin). Proc. Nat. Acad. Sci. U. S. A.; 71: No. 2, 586-589(Feb 1974).

After bacteriophage T7 infection, a protein kinase (EC 2.7.1.37; ATP : protein phosphotransferase) activity can be demonstrated in E. coli in vivo by sodium dodecyl sulfate–polyacrylamide gel electrophoresis and autoradiography. Cell-free extracts catalyzed the transfer of the terminal phosphoryl group of [γ-^{32}P]ATP to endogenous protein acceptor or to added histone. The bond between phosphate and protein shows the characteristics of serine phosphate: it is stable in 1 N HCl (100°) and cleaved by 1 N KOH (37°) and by alkaline phosphatase treatment. Moreover, after partial acid hydrolysis, radiophosphate migrates with marker O-phosphoserine on polyethyleneimine-cellulose thin-layer chromatograms. Enzyme activity in uninfected cells is negligible. Ultraviolet irradiation of the phage genome prevents the appearance of the protein kinase; irradiation of the host genome does not. The enzyme activity occurs 4 min after infection and its gene maps in the early region (promoter proximal to gene 1). Ribosomal proteins are phosphorylated in vivo and are substrates in vitro. Enzyme activity in vitro is not changed by addition of cyclic AMP or cyclic GMP. (auth)

Radiation Effects on Plants

Refer also to abstracts 24399 and 24400.

24452 (INIS-mf-733) POSSIBILITIES OF INCREASING MAIZE PROTEIN CONTENTS BY MEANS OF MUTATION BREEDING. Popova, J.; Stoilov, M. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. vp. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Seeds of several maize hybrids, varieties, and one self-pollinated line were irradiated with gamma rays (6, 10, and 12 kR). Raw protein, tryptophan and lysine, was determined in M_2, M_3, and M_5 of some mutant types. Improved lines with significant increases of protein in comparison to the initial types were obtained. Mutation line 825-5, which is almost three times richer in lysine in comparison to the initial line 38-11, is the most interesting. Its contents of lysine synthetic A is greater also. Data show that experimental opaque mutation was obtained. Morphologically this mutation is not different from the initial line. (auth)

24453 (INIS-mf-735) NATURE AND POSSIBILITIES OF MUTATIONS INDUCED WITH GAMMA RAYS. Savov, P. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 11p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

The influence of gamma rays on hereditary modifications related to quantitative and qualitative characters of different varieties of wheat was studied for a period of several years. Irradiation doses of 5, 10, and 15 kR were utilized. Seeds of 10 Bulgarian and foreign varieties, differing substantially by the most important biological and commercial qualities and characters were irradiated. Hybrid seeds, obtained by crosses of initial varieties, were irradiated simultaneously with the initial varieties. Hereditary modifications were obtained in relation to the height of the stem, the ear structure, the size and the disposition of the foliage, the vegetative period, etc. On the basis of the material obtained, generalizations were made on mutation modification possibilities in Triticum genus. (auth)

24454 (INIS-mf-736) INDUCED MUTATIONS IN PEAS. Vasileva, M. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 18p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Investigations were conducted to establish the mutability of different pea varieties when irradiated with gamma rays (^{60}Co) and the possibility of utilizing the obtained mutant types in mutation breeding. A great variety of mutants, of interest for further genetics and breeding studies, were obtained. Reactions were different in each different variety. (auth)

24455 (INIS-mf-737) RADIOINDUCED FORMS IN TOMATOES AS CARRIER OF GENETIC MARKER. Dorosiev, L. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 3p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

By means of irradiation with a dose of 1000 R gamma rays (^{60}Co) of seedlings in the bud formation phase of F$_1$ hybrid Line C-1 (determinant with usual leaf type) x line St F 52/19 (indeterminant with potato type of leaf) the strong adhesion is overcome between the closely situated genes in the sixth chromosome conditioning the determinant type of growth and the common type with strongly indented leaves. The strong adhesion between the genes prevents the formation of determinant forms with potato type of leaves by hybridization by applying additional methods as is the case of irradiation with gamma rays. From the two explanations of the origin of the form obtained, mutation and radiation effect on the crossing-over, more probable is the latter. The newly obtained recombination appears as a valuable carrier of a recessive genetic marker (potato leaf), which in the heterosis seed production of determinant tomatoes was not encountered so far. (auth)

24456 (INIS-mf-738) STUDIES ON INDUCED MUTANTS IN PEPPERS. III. Mutants of "Gold Medal" Variety. Daskalov, S. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 19p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

By irradiation with 13 KR gamma rays of dry seeds of the "Gold Medal" variety, mutant types were obtained in M$_2$, which can be utilized for genetic studies, breeding, and biological and physiological research. A short description is given of morphological and genetic characters of three male sterile forms, of one anthocyanin-deficient mutant, which can be utilized as direct variety or applied as a genetic label in the production of hybrid seeds, as well as of one dwarf mutant, which can be utilized in theoretical mutation research. (auth)

24457 (INIS-mf-739) EFFECT OF COMBINED APPLICATION OF IONIZING RADIATION WITH CHEMICAL MUTAGENS IN EXPERIMENTAL MUTAGENESIS IN PEAS. Mekhandzhiev, A. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 17p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

The possibility of increasing the frequency of induced mutations by means of combined treatment with ionizing radiation (fast neutrons and gamma radiation) and chemical mutagens was studied. The investigations included effects of radiation dose and mutagen concentrations. Results showed that the mutation frequency was increased by the combined treatment. The possibility of obtaining improved varieties by using the combined treatment and applications to mutation breeding are discussed. (HLW)

24458 (INIS-mf-740) INVESTIGATION ON MUTAGENIC EFFECTS OF GAMMA RAYS AND FAST NEUTRONS ON PISUM SATIVUM. Mekhandzhiev, A.; Vasileva, M. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 15p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Investigations were carried out for the determination of mutagenic effects of gamma rays and fast neutrons on four pea varieties. Irradiation doses were: 1, 5, 10, 15 KR gamma rays (^{60}Co) and fast neutrons respectively 100, 500, 1000, 1500 Rads, with two intensities. Mutagenic effects were estimated on the basis of plant germination, survival, and development in M$_1$ and of chlorophyll and morphological mutations in M$_2$ and M$_3$. It was found that the mutagenic reactions of the varieties was different for both types of radiation. (auth)

24459 (INIS-mf-741) BIOLOGICAL AND BIOCHEMICAL MODIFICATIONS IN PAPAVER SOMNIFERUM L. UNDER THE INFLUENCE OF IONIZING RADIATION. Ilieva, S.; Mekhandzhiev, A.; Mateeva, D.; Dimitrova, S. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 20p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Investigations on plant radiosensitivity and morphological modifications in M$_2$ irradiated with different gamma doses and fast neutrons of two poppy varieties (Papaver somniferum L.) were carried out. Growth and development of plants in M$_1$ when irradiated with the two sources of radiation were studied. Plant morphological modifications in M$_2$ and their inheritance in M$_3$ were studied. Biochemical analyses were carried out in order to establish modifications of alkaloid contents in plants irradiated with gamma rays and neutrons. (auth)

24460 (INIS-mf-742) INFLUENCE OF THERMAL SHOCK ON THE SOMATIC AND GENETIC EFFECTS FROM GAMMA IRRADIATION OF DORMANT SEEDS OF ARABIDOPSIS THALIANA (L.) HEYNH. Nikolov, Ch.; Ivanov, V. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 11p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Seeds from Arabidopsis thaliana (L.) Heynh. Ep-I race, with 6% moisture content, were heated in the course of 30 minutes at a temperature of 100°C prior and after irradiation with gamma rays. The plants were grown under aseptic conditions on mineralized agar medium. The survival rate, the growth, the duration of the separate phases of development, the fruitfulness, and the mutations in M$_2$ and M$_3$ were determined. Inferences were drawn for the differentiated somatic and genetic radiation effects. (auth)

24461 (INIS-mf-743) EFFECT OF THE IRRADIATION WITH ^{137}Cs GAMMA RAYS ON THE RADIOSENSITIVITY OF THE SOMNIFEROUS POPPY (P. SOMNIFERUM L.) AND THE MORPHINE CONTENT IN THE DRY CAPSULES IN M$_1$ AND M$_2$. Popov, P.; Dimitrov, J.; Georgiev, S. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. vp. (In Bulgarian). Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia, Bulgaria.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Seeds of the varieties P-360 (blue flowers), C-188 and C-230 (white flowers) from Ssp. Turcicum and Novinka 198, Hatwan and Morphine (blue flowers) from Ssp. Eurasiaticum were irradiated a single time with gamma rays from ^{137}Cs at doses of 5, 10, 15, 20, 25, 30, 35, and 40 KR with a radiation dose rate of 16 R/min. On the basis of field observations and laboratory analysis some conclusions were drawn. The lethal dose is different for the separate varieties. For the Novinka variety it is 35 KR and for the varieties C-230, Hatwan and Morphine it is 30 KR. The P-360 and C-188 varieties survived at 40 KR. The morphine content in the dry poppy capsules in M_1 varies in a wide range and depends on the variety and the irradiation dose. The increased morphine percentage in the dry capsules in M_1 is preserved in M_2 after irradiation with doses of from 15 to 35 KR for the P-360 and C-230 varieties and with 25 KR for the Morphine variety but disappears completely in the Hatwan variety. (auth)

24462 (INIS-mf-744) POSSIBILITIES FOR PRODUCING DIVERSE INITIAL MATERIAL OF PEANUTS (A. HYPOGEAEA L.) BY IRRADIATION OF THE SEEDS WITH ^{60}Co GAMMA RAYS. Popov, P.; Dimitrov, J.; Georgiev, S. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. vp. (In Bulgarian). Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia, Bulgaria.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Seeds of the peanut varieties "Sadovski amended" and "Velikan" were irradiated with ^{60}Co gamma rays and their behavior in M_1, M_2, and M_3 was studied. On the basis of field observations and laboratory analysis some conclusions were drawn. Peanut varieties of the Valencia type react in a different way in M_1 to irradiation with ^{60}Co gamma rays at a dose of 18 kR. From the Velikan variety only 11.8% survived and gave seeds, and from the Sadovski amended form, 2.1 per cent. In M_2 and M_3 a greater variety was obtained both in the plant morphology and in the economically useful properties of interest for the selection. These changes are more strongly expressed in the Velikan hybrid variety as compared to the Sadovski amended variety, obtained after repeated individual selection. The irradiation of seeds with ^{60}Co gamma rays at a dose of 18 kR appears to be a promising selection method for producing rich initial material with the peanuts. (auth)

24463 (INIS-mf-747) EFFECT OF CERTAIN PHYSICAL MUTAGENS ON THE SEEDS OF FIELD BEANS. Staneva, B. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 19p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Studies were conducted consecutively on the radioresistance of five varieties of field beans with different genotypes and types of seeds to different doses of gamma rays; of one variety with air dried seeds to fast and thermal neutrons; of air dried and soaked seeds during 12 and 24 hours to gamma rays; and of dormant and germinated seeds to x rays. The biological effect of these mutagens was determined with respect to germination dynamics, number of sprouted, survived, fertile and sterile plants and other quantitative characteristics (fertility of the fertile plants); in certain mutants anaphase analysis of the roots was made. In M_2 (second generation) the frequency and spectrum of mutations were determined. Comparative tests were conducted on economically valuable varieties including those with increased and qualitatively improved protein content. Seven micro-mutants were established exceeding in yield the control variety by 5 to 9% and many mutants with 1.5 to 5% more protein than the initial variety. A number of economically valuable micro-mutants are to be tested. (auth)

24464 (INIS-mf-748) INDUCED MUTATIONS IN WINTER TWO-ROW BARLEY. Stefanov, T. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 16p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Gamma rays (^{60}Co) (5 to 50 kR doses on dry seeds) were utilized as the mutagenic agent in the variety Beta Ketsoras. A great number of lines were obtained with shorter periods of vegetation, short and good lodging resistance straw, improved winter hardiness, improved quality of grain, many of which were utilized as initial material in further selection studies. During the period 1970/71 and 1971/72 as a control and preliminary variety test, 57 mutant lines were investigated, of which 14 yield with 8.16 to 26.91% gave higher-yielding than the initial variety and average yield of Beta Ketsoras of 559 kg per $^1/_4$ acre. Observations on winter hardiness of induced mutants show that several of these mutants possess a higher winter hardiness than the parent variety. For instance 71.21 to 77.78% of Beta Ketsoras plants survived during the winter period of 1972, while the survival percentage of mutant lines in M 3266/610, M 3465/656, M 3764/717 is 92.32 to 99.34. Mutant 1014/161 is remarkable for its absolute and per hectolitre weight, better kernels and surpasses by its technological qualities the initial variety. Mutant 3139/576 is the higher-yielding among the tested lines and outclasses the parent variety with 26.91%, or with 147 kg grain per $^1/_4$ acre. (auth)

24465 (INIS-mf-749) MODIFICATION OF BEAN CHARACTERS BY GAMMA IRRADIATION. Rukmanski, G. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 14p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Seeds of garden beans variety Professor were gamma-irradiated with 4, 6 and 8 kR. First and second generations were obtained. Modifications of essential characters in comparison to control plants were studied. For the elucidation of the nature of observed modifications in M_2, a third generation was grown. As a result of this experiment it was found that gamma irradiation influences hereditary changes in several important bean characteristics. Description, analysis, and commercial estimation of modified characteristics are given. (auth)

24466 (INIS-mf-750) DESCRIPTION OF SOME BARLEY MUTANT FORMS OBTAINED BY IRRADIATION OF SEEDS WITH IONIZING RADIATION WITH DIFFERENT LET. Fedin, P. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 9p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

The aim of the investigations is to study the relationship between temperature shock influence on radiobiological reactions in M_1 and the frequency of induced mutations in M_2. For this purpose seeds of two-row brewery barley of Beta Ketsoras variety were irradiated with dose of 20 kR ^{60}Co gamma rays and dose intensity of 504 R/min and fast neutrons with a dose of 400 Rads and dose intensity of 1412 rads/hour. The seeds were divided in two lots, one lot was stored at a temperature of −196°C before and after the irradiation, the other at a temperature of +60°C. Irradiated seeds with the same doses, but without temperature treatment, were utilized as controls. There was not a direct relationship of the temperature shock influence to radiobiological reactions in M_1. For instance, the frequency of chlorophyll mutations did not change under the influence of temperature before irradiation of the seeds. The quantity of morphological mutations did not change. Furthermore, the frequency of chromosomal aberrations was reduced. A series of mutant types with morphological and physiological modifications of interest for selection experiments are described. Types with short stems, as well as with 10 to 12 days earlier ripening in comparison to control were obtained. (auth)

24467 (INIS-mf-756) GAMMA EFFECTS ON SEEDS AND CUTTINGS OF CERTAIN VINE VARIETIES OF THE VITIS VINIFERA L. SPECIES. Kondarev, M.; Bozhinova, I. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 19p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

The separate vine varieties exhibit different degrees of radioresistance following irradiation of stratified seeds with gamma rays. The low-dose irradiation with gamma rays exerts a stimulating effect on the rate of germination. The higher the radioresistance of the variety the bigger is the limit of the doses and vice versa. Doses above 10,000 R are practically lethal since the seeds that germinated after irradiation cannot grow as plants and perish at different stages of their development. The dose 10,000 R appears lethal or sub-lethal depending on the radioresistance of the vine variety since separate plants of certain varieties survive. The most appropriate dose for irradiating cuttings for green grafting with the aim of provoking mutational changes appears to be 2000 R at which is achieved successful grafting and development of the grafts with well expressed radiomorphoses. Doses of 4000 and 6000 R kill the leading shoot and in spite of the fact that the shoots remain green and fresh until the autumn the bud does not develop into shoot. That is why they are considered lethal. Irradiation with 8000 R causes radical changes leading to lack of callus formation and low rate of successful grafting owing to which the dose is considered absolutely lethal. (auth)

24468 (INIS-mf-757) IRRADIATION OF VINE POLLEN WITH GAMMA RAYS. Bozhinova, I. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. vp. (In Bulgarian). Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia, Bulgaria.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

The effect of gamma irradiation on the viability and pollination capacity of Vitis vinifera L. pollen was investigated. Results obtained from the investigations carried out in the course of 4 years make it possible to make the following conclusions: Gamma irradiation of vine pollen affects its germination on an artificial nutritive medium. The low doses of 500 and 1000 R exert certain stimulating effects. The pollen germination deteriorates with the increase of the doses since the development of the pollen tubes is inhibited. The dose of 60,000 R does not lead to complete loss of the pollen viability. The increased doses of gamma irradiation of the vine pollen reduce its fertility leading to an increase of the percentage of the undeveloped grains in the branches and reduction of the number of the normal grapes. At irradiation with doses above 20,000 R an ever decreasing part of the flowers develop into grapes, parthenocarpic and normal. At a dose of 60,000 R most of the catkins wither as unpollinated but certain catkins are observed with 2 to 3 very small green grapes. At irradiation of vine with gamma rays for selection purposes doses of 5000 to 10,000 R are considered optimal at which more seeds and developed seedlings are obtained. Doses above 20,000 R appear lethal. (auth)

24469 COMPARISON OF MUTAGENIC EFFECTIVENESS AND EFFICIENCY OF GAMMA RAYS, EMS, NMU, AND NG. Prasad, M. V. R. (Indian Agricultural Research Inst., New Delhi). Indian J. Genet. Plant Breed.; 32: No. 3, 360-367 (Nov 1972).

The mutagenic effectiveness of γ rays, EMS, nitrosomethyl urea (NMU), and nitrosoguanidine (NG) was compared on seeds of Triticum durum Desf. cultivar N. P. 404. Although all mutagens produced similar seedling growth inhibition, the highest frequency of chlorophyll mutations was in NMU treatment. No variants were observed in NG treatment. Gamma rays and EMS were next to NMU treatment for frequency of chlorophyll mutations. (ERB)

24470 SEL'SKOKHOZYAISTVENNAYA RADIOBIOLOGIYA. (Agricultural Radiobiology). Gulyakin, I. V.; Yudintseva, E. V. Moscow; Kolos (1973). 272p.

Following a general background of information on nuclear physics related to radiation, natural and artificially created radioisotopes, and dosimetry, the subjects discussed in a very general way include the action of ionizing radiation on plants, the significance of radioactive fission products in agriculture, the properties of such products in the environment of plants, the behavior of radioactive fission products in the soil, the entrance of ^{90}Sr and ^{137}Cs into plants from the soil, methods of predicting the radiostrontium content of harvested plants and ways to decrease the radioactive fission product content of the harvest, the use of radioactive isotopes in agricultural practice, and precautions to be used in working with radioactive substances. (MWG)

24471 TEMPERATURE DEPENDENCE OF THE RADIOSENSITIVITY OF GRASS SEEDS. Verho, S.; Rissanen, P. M.; Spring, E. (Univ. of Helsinki). Strahlentherapie; 146: No. 4, 469-472(Oct 1973).

A study was made of the influence of object temperature on the radiosensitivity of humid grass seeds (Lolium multiflorum), along with that of temperature alone: Temperature here refers to that during irradiation. It was observed, within the limits of experimental error, that the radiosensitivity remains constant in irradiation with cobalt-60 gamma radiation within a temperature range of 5 to 30°C. At temperatures of about 40 to 43°C, a clear increase was found in the radiosensitivity, along with a clear destructive effect of the temperature itself. (auth)

24472 PROTIVOLUCHEVAYA ZASHCHITA I POSTRADIATSIONNOE VOSSTANOVLENIE RASTENII. (Protection against Radiation and the Postradiative Rehabilitation of Plants). Grodzinskii, D. M. (ed.). Kiev; Naukova Dumka (1972). 168p.

The results of theoretical and experimental studies on the following questions are given: free radical states in radiation-damaged plants, radiation damage to the biosynthesis of nucleic acids and albumin, their postradiation recovery, radiosensitivity of microalgae, and postradiation recovery of cell populations. (tr-auth)

24473 GENES, ENZYMES, AND POPULATIONS. Proceedings of the Twelfth International Latin American Symposium Held in Cali, Colombia, November 27–December 1, 1972. Srb, A. M. (ed.). Basic Life Sciences, Volume 2. New York; Plenum Publishing Corporation (1973). 372p. (CONF-721102-). $27.00.

A separate abstract was prepared for one of the 26 papers included that discuss various fundamental approaches to agricultural plant improvements. Abstracts of three papers appeared in NSA previously as numbers 27:02732, 27:12272, and 28:05940. (CH)

For an abstract of an individual paper see: 24511.

Radiation Effects on Animals

Refer also to abstracts 24422 and 26514.

Man

Refer also to abstracts 26368, 26461–26463, and 26515.

24474 (CEA-CONF-2538) PROBLEMS OF DOSIMETRY IN ADVANCED RADIOTHERAPY. Chemtob, M.; Parmentier, N. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1973. 32p. (In French). (CONF-731064-1). Dep. NTIS (U. S. Sales Only) $3.75.

From 7th meeting in the framework on radioprotection; Split, Yugoslavia (22 Oct 1973).

The techniques used and the results obtained in the dosimetry and microdosimetry of radiations with high LET are discussed. The radiations considered are neutrons from a Be target bombarded with deuterons at 16, 33, and 50 MeV; neutron radiation from a ^{252}Cf source; and α radiation accelerated to obtain energies of the order of 600 MeV. The results showed that radiations with high LET bring improvements in the treatment of some types of tumors. It is stressed however that before the treatment of patients with these radiations certain studies are necessary. The first is the dosimetric and microdosimetric study to orient the RBE so as to choose the radiation to be used. The second is radiobiological studies on different tests to estimate the RBE, oxygen enhancement ratio, and the role of dose fractionation. For example in the case of heavy ions it is desirable to use nitrogen or carbon nuclei. In the case of neutrons the D(L) distribution should cover LET ranges higher than 100 keV/μ so that the oxygen enhancement ratio is reduced, but the proportion of these LET's should not be so large that the RBE is in the saturation zone. (JSR)

24475 (COO-3387-2) STATISTICAL ANALYSIS OF LONGITUDINAL GROWTH DATA ON ADOLESCENTS EXPOSED IN UTERO TO THE ATOMIC BOMBS, HIROSHIMA AND NAGASAKI. Final Report, January 1, 1971–February 29, 1972. Pasternack, B. S. (New York Univ., N.Y. (USA). Inst. of Environmental Medicine). 31 Mar 1972. Contract AT(11-1)-3387. 68p. Dep. NTIS $5.50.

Since 1950 approximately 1600 exposed and control subjects who were in utero at the time of the atomic bombings (ATB) of Hiroshima and Nagasaki have been studied. The sample was drawn from the population of in utero children ATB who were either exposed or non-exposed (entering Hiroshima and Nagasaki between October 1945 and October 1955). Matching of subjects was carried out so that all available children exposed under 2,000 m were entered into the study. For each child exposed proximally an attempt was made to include a child exposed distally and one not-in-city ATB, matched by sex, month of birth, and economic status. Children at all stages of gestation were included. During the past year, a four parameter Gompertz-type model was used to characterize growth during adolescence for Japanese subjects who were in utero at the time of the atomic bombings of Japan in 1945. Based on maximum likelihood estimates of the four parameters, statistical analyses were performed to test for differences between sexes, cities, trimesters ATB, and exposure groups. The results obtained indicated that: males significantly differed from females in all comparisons; differences among male exposure groups (indicating some impairment in adolescent growth) were greater than those for females; males and females in Nagasaki differed from those in Hiroshima, respectively; differences among trimester ATB groups were, almost without exception, non-significant; and age at onset of menarche and estimated age at the second point of inflection of the Gompertz growth curve were closely related. (auth)

24476 (INIS-mf-887, pp 158-169) BEHAVIOR OF CERTAIN FISSION PRODUCTS AND RADIOACTIVATION PRODUCTS IN ENVIRONMENT AND CALCULATION OF EXTERNAL AND

INTERNAL RADIATION DOSES. Grechushkina, M. P. [nd]. (In Russian).

The concepts of external and internal exposure are briefly reviewed and the calculation of external exposure doses and doses resulting from inhalation of radionuclides and from ingestion of radionuclides in the food chain is discussed. Main results are tabulated. (INIS)

24477 (INIS-mf-887, pp 174-188) ESTIMATING THE CONSEQUENCES OF ENVIRONMENTAL CONTAMINATION WITH ARTIFICIAL RADIOACTIVITY: EXPERIENCE OF THE U. N. RADIATION COMMITTEE. Zeleny, V. (Ceskoslovenska Akademie Ved, Prague). [nd]. (In Czech).

The concepts of the main recommendations and standards set by the United Nations Scientific Committee on the Effect of Atomic Radiation are discussed. A review is also given of the most frequent and significant sources of environmental contamination with artificial radioactivity. (INIS)

24478 (JPRS-61236-1) CONCISE HANDBOOK ON SPACE BIOLOGY AND MEDICINE. Part I. Burnazyan, A. I.; Gazenko, O. G.; Parin, V. V. (eds.). (Joint Publications Research Service, Washington, D. C. (USA)). 15 Feb 1974. Translated from Kratkiy Spravochnik po Kosmicheskoy Biologii i Meditsine, 1972, Moscow. 230p. NTIS.

Definitions are presented for more than 2,000 terms used in theoretical and applied space biology and medicine and related fields, and associated with the support of manned flights aboard spaceships and in orbital stations. (auth)

24479 (JPRS-61236-2) CONCISE HANDBOOK ON SPACE BIOLOGY AND MEDICINE. Part II. Burnazyan, A. I.; Gazenko, O. G.; Parin, V. V. (eds.). (Joint Publications Research Service, Washington, D. C. (USA)). 15 Feb 1974. Translated From Kratkiy Spravochnik po Kosmicheskoy Biologii i Meditsine, 1972, Moscow. 501p. NTIS.

Definitions are presented for more than 2,000 terms used in theoretical and applied space biology and medicine and related fields, and associated with the support of manned flights aboard spaceships and in orbital stations. (auth)

24480 (LBL-1505) MEASUREMENTS OF COSMIC RADIATION DOSE IN SUBSONIC COMMERCIAL AIRCRAFT COMPARED TO THE CITY-PAIR DOSE CALCULATION. Wallace, R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 16 Jul 1973. Contract W-7405-eng-48. 74p. Dep. NTIS $5.45.

The radiation dose received by passengers during flight on conventional jet aircraft was determined as a function of exposure to cosmic radiation, solar radiation, flight time, and flight path. The dosimetric measurements were made with thermoluminescent dosimeters (TLD's) and with emulsions of three types sealed in plastic packets. These packets were sent by air mail back and forth from Berkeley, California to five cities and a dose sufficiently above background for a satisfactory measurement was accumulated by the TLD's on one round trip and by the emulsions on three round trips. It was concluded that both experiments and theory show that the total doses received at present day conventional jet aircraft altitudes are considerably higher than those encountered in supersonic flights at much higher altitudes, even though the dose rate is lower at these lower altitudes, when the longer time of exposure at the lower altitudes is taken into consideration. Computer programs used in the dose calculations are included. (CH)

24481 (NIRS-AR-14) ANNUAL REPORT FOR NATIONAL INSTITUTE OF RADIOLOGICAL SCIENCES, FOR FISCAL 1971. (National Inst. of Radiological Sciences, Chiba (Japan)). 1 Oct 1972. 130p. (In Japanese). NTIS (U. S. Sales Only).

The annual report described the research for survey, technical cooperation, training, medical examination, management of the Tokai branch, and library service in 1971. As special studies from last year, the implantation of hematopoietic organs in the radio-medical field and the medical usage of neutron beams were studied. Cyclotron equipment for utilizing neutron rays is scheduled to be completed at the end of 1973. In this year the study was done by Van de Graaff accelerator. The subjects in this year were collection and management of gamma camera data and intestinal bacterial flora to insert into SPF mice. In the annual studies, there were 71 subjects including 7 new subjects in this year, and these subjects were studied independently with a long-term plan in 12 sections. Studies on survey in the sea, centering at the marine laboratory, were concerned with concentration of radionuclides in fish, shell-fish, and seaweeds by radioisotope tracer and quantitative analysis of stable isotope, development of monitoring method for radioactivity in the marine organisms, and estimation of radiation exposure dose in human body accompanied with radiation pollution at the coast. The research on the actual condition were done on survey of Bikini victims, survey of the working environment using uranium fuel, and national dose for medical radiation. (JA)

24482 (ORNL-TM-4490) CALCULATED PHYSICAL AND BIOLOGICAL RESULTS WHEN NEGATIVELY CHARGED PIONS ARE USED TO IRRADIATE A SMALL AND A LARGE "TUMOR" VOLUME IN A TISSUE PHANTOM. Santoro, R. T.; Alsmiller, R. G. Jr. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 19p. Dep. NTIS $3.00.

The calculated absorbed doses, LET spectra, cell-survival probabilities, oxygen enhancement ratios, and relative biological effectiveness are presented and compared for two negatively charged pion beams, each incident on a 30-cm-thick tissue phantom. All of the biological results were obtained using the cell-inactivation model of Katz et al and parameters for T-1 human kidney cells. The beam parameters were chosen to produce an approximately uniform absorbed dose in a small (2 cm in depth and 1 cm in radius) and in a large (5 cm in depth and 2.5 cm in radius) cylindrical tissue volume, each centered about a depth of 15 cm in the phantom. (auth)

24483 (RPS-AR-6) ANNUAL REPORT FOR 1972. (Ministry of Public Health, Bangkok (Thailand). Radiation Protection Service). 1972. 41p. Dep. NTIS (U. S. Sales Only) $4.25.

Activities of the Radiation Protection Service of the Department of Medical Sciences, Ministry of Public Health, Thailand, during 1972 are summarized. Activities included: radiation protection surveys in medical facilities using x radiation for diagnosis and therapy or sealed ^{226}Ra sources for therapy; and radiation protection surveys of x ray machines used for industrial purposes. Radiation source calibration, methods used for the dosimetry of personnel and patients, investigations of population exposure, and training courses are discussed. (CH)

24484 RELATIONSHIP OF NSD TO REACTIONS AND COMPLICATION FOLLOWING TREATMENT FOR MALIGNANT UTERINE CERVICAL NEOPLASMS. Buchler, D. A. (Univ. of Wisconsin, Madison); Kline, J. C.; Peckham, B. M.; Ellis, F. Radiology; 110: No. 3, 687-690(Mar 1974).

From 58th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, Illinois (26 Nov 1972).

In an attempt to relate nominal standard dose (NSD) to reactions and complications, the records of 516 patients who had received high dose radiotherapy for invasive squamous cell carcinoma of the uterine cervix were studied. There were two treatment plans: (a) Plan I: two applications of intracavitary radiation plus parametrial radiation; and (b) Plan II: external radiation to the midplane of the pelvis, followed with one intracavitary application. The ret dose calculated at the end of therapy revealed a significant statistical correlation between reactions and dosage in both plans, i.e., .0000029 and .033, respectively. At maximal recovery, however, no significant correlation was seen for patients in Plan I and only borderline significance for those in Plan II. (auth)

24485 METHOD OF ESTIMATING BIOLOGICAL EFFECT OF COMBINED INTRACAVITARY LOW DOSE RATE RADIATION WITH EXTERNAL RADIATION IN CARCINOMA OF THE CERVIX UTERI. Ellis, F.; Sorensen, A. (Medical Coll. of Wisconsin, Milwaukee). Radiology; 110: No. 3, 681-686(Mar 1974).

Figures were derived representing the biological effect of radiotherapy on normal tissues in cases of carcinoma of the cervix. The doses causing both early and late effects are calculated by using quantitative relationships determined from clinical considerations between physical factors (dose, time-dose rate, fraction dose, and numbers of fractions) and the effects to calculate the combined effects of the two modalities of radiation at significant points in the pelvis. Sample calculations are shown for techniques used at some major clinical centers. (auth)

24486 ^{60}Co DOSIMETRY WITH A DESK-TOP COMPUTER. Fitzgerald, L. T.; Mauderli, W.; Schulman, J. (Univ. of Florida, Gainesville). Radiology; 110: No. 3, 677-680(Mar 1974).

Polynomial central-axis depth-dose approximations for ^{60}Co γ radiation were developed and used with a small desk-top computer to determine treatment time and 5-mm given dose for a variety of treatment conditions. Deviation of the polynomial approximations from manually calculated values is less than 1%. This method provides a quick and easy means of obtaining the treatment time and 5-mm given dose corresponding to a chosen tumor dose and eliminates the need for manual calculations and the use of tables, thereby reducing the chance of human error. (auth)

24487 SEQUELAE OF PELVIC IRRADIATION IN INFANCY: 25-YEAR FOLLOWUP. El-Mahdi, A. M.; Marks, R. Jr.; Thornton, W. N.; Constable, W. C. (Univ. of Virginia, Charlottesville). Radiology; 110: No. 3, 665-666(Mar 1974).

Late radiation changes are reported in a 25-year-old woman whose entire pelvis was x irradiated at the age of 13 months. Changes were apparent in the skin, muscles, primary sexual organs, bone, and bone marrow. No clinically manifested late radiation effects were revealed in the bladder or rectum. In view of the dose delivered (2,200 rads), it would appear that the normal tissues of infants are highly sensitive to irradiation. (auth)

24488 SURVIVAL OF MURINE LEUKAEMIA CELLS EXPOSED TO ^{252}Cf NEUTRONS UNDER CONDITIONS SIMULATING IMPLANTATION OF THESE SOURCES INTO TISSUE IN RADIOTHERAPY. Berry, R. J. (Churchill Hospital, Oxford); Oliver, G. D. Jr.; George, D. L.; Werner, J.; Brennan, J. T. Brit. J. Radiol.; 46: No. 551, 996-1004(Nov 1973).

Murine P-388 leukemia cells were irradiated with either radium γ rays, or the mixed fast neutron and γ emission from ^{252}Cf, in a geometrical set-up simulating the use of such sources in brachyradiotherapy. Survival of reproductive capacity of the tumor cells was assayed in vivo. At the relatively high dose rates used (circa 240 to 280 rads/hr) the relative biological effectiveness (RBE) of the fast neutrons from ^{252}Cf was 2.7 to 3.8 for irradiation under aerobic conditions and 3.3 to 5 for irradiation in nitrogen. The oxygen enhancement ratio (OER) was 2.3 for irradiation with radium γ rays and 1.9 for irradiation with ^{252}Cf, a potential therapeutic gain factor (TGF) circa 1.2 for the use of these sources in treatment of tumors containing significant proportions of hypoxic cells. (auth)

24489 QUANTITATIVE STUDY OF LATE RADIATION EFFECT ON NORMAL SKIN AND SUBCUTANEOUS TISSUES IN HUMAN BEINGS. Arcangeli, G.; Friedman, M.; Paoluzi, R. (Istituto Regina Elena, Rome). Brit. J. Radiol.; 47: No. 553, 44-50(Jan 1974).

A retrospective study of late effects of irradiation on skin and underlying connective tissues in 94 testis tumor patients was conducted 5 to 8 years after irradiation. The late lesions were classified into five degrees of severity of injury. Among this population of patients, there was marked variation of severity of injury produced by similar dosage; or when viewed differently, each degree of severity of injury was produced by a wide range of doses. Therefore, since the late response of connective tissues was not constant, a tolerance dose could not be established, but only a percent probability of threat of a specific degree of injury. Within certain limits, the late effects were independent of overall time and dependent on the size of the daily fraction. Biological features of non-proliferating connective tissue were not applicable to dynamically proliferating normal epithelial and cancerous tissues. (auth)

24490 FIBROSARCOMA. A Complication of Interstitial Radiation Therapy for a Benign Haemangioma Occurring After 18 Years. Gray, G. R.; Freedman, S. I.; Kagan, A. R. (Cedars-Sinai Medical Center, Los Angeles). Brit. J. Radiol.; 47: No. 553, 60-61(Jan 1974).

A briefly summarized case history is presented of a fibrosarcoma occurring in a 62-year-old male, treated 18 yr previously by radiotherapy for a benign hemangioma on the medial aspect of an ankle. Treatment was with 8 radium needles and 32 radon seeds. Estimated dose to the immediately adjacent tissues was about 15,000 rads. (UK)

24491 URETERAL OBSTRUCTION AFTER RADIOTHERAPY OF CERVICAL CANCER. Derevyanko, I. M.; Pashkova, L. M. (Medical Inst., Stavropol, USSR). Vop. Onkol.; 19: No. 12, 26-30 (1973). (In Russian).

Ureteral obstruction after radiotherapy for cancer of the uterine cervix can be due to cancer recurrence and radiation scarring strictures. Isotope renography is a reliable method that evidences disorders in the urine passage along the ureter, but nevertheless to recognize the cause of ureteral occlusion patients should undergo gynecological and urological investigation. The authors have observed 38 patients suffering postradiation strictures of the ureters. Seventeen patients showed bilateral ureteral strictures, twenty one patients, unilateral. Recognition of radiation scarring strictures of the ureter in due course would enable more frequently to perform operations on the ureters, contributing to restoration of the urinary passage. (auth)

24492 RESULTS OF ^{131}I THERAPY IN FUNCTIONAL THYROID ADENOMAS. Holan, T.; Miclutia, M.; Derevenco, V. Stud. Cercet. Endocrinol.; 23: No. 4, 271-279(1972).

Of the 1050 patients subjected to ^{131}I radiotherapy in the years 1960 to 1969, 242 (20.1%) showed hyperfunctional adenomas characterized scintigraphically as autonomous thyroid adenomas (ATA). A rigorously individualized treatment in terms of the particularities of the patient and disease resulted in improvements in 82.6% of the subjects. In cases requiring surgery (young people involving genetic risks, multinodular adenomas, etc.), the intervention should be preceded and guided by scintigraphic scanning. (Rom. Sci. Abstr.)

24493 SOMNOLENCE AFTER PROPHYLACTIC CRANIAL IRRADIATION IN CHILDREN WITH ACUTE LYMPHOBLASTIC LEUKAEMIA. Freeman, J. E.; Johnston, P. G. B.; Voke, J. M. (Saint Bartholomew's Hospital, London). Brit. Med. J.; 4: No. 5891, 523-525(1 Dec 1973).

A transient cerebral disturbance characterized by somnolence of varying degree is described in children after cranial irradiation given as part of central nervous system (C.N.S.) prophylaxis for acute lymphoblastic leukemia in remission. Out of 28 such children receiving cranial irradiation from a telecobalt unit as part of the Medical Research Council protocol for C.N.S. prophylaxis 11 (39%) developed pronounced symptoms of somnolence, anorexia, and lethargy some six weeks after the completion of cranial irradiation, and a further 11 (39%) developed these features in mild form. In all cases the symptoms were transient, no focal neurological abnormality was detected, and all children made a spontaneous and complete recovery. E.E.G. studies on five somnolent children showed similar abnormal activity of diffuse and patchy distribution over both hemispheres. Indirect evidence is presented to support the concept that this syndrome represents a transient radiation encephalopathy, analogous to acute transient radiation myelopathy, caused by temporary disturbance of myelin synthesis. (auth)

24494 PRIMARY RETICULUM CELL SARCOMA OF THE FEMUR: 12-YEAR FOLLOW-UP AFTER RADIATION THERAPY AND PATHOLOGIC FRACTURE. Boyes, J. G. Jr. S. Med. J.; 67: No. 3, 335-339(Mar 1974).

One patient with a histologic diagnosis of reticulum cell sarcoma of the femur was observed for 12 years following high voltage irradiation to the entire femoral shaft (4,000 rads). A pathologic fracture occurred through the initial biopsy site. Several efforts at external and internal fixation were made, and homologous and autogeneous bone grafts were used in an effort to obtain healing of the fracture and to revascularize the femur. The femur was biopsied on several occasions and showed no recurrence of tumor, but did demonstrate radioinduced avascular necrosis. Twelve years after original diagnosis, the patient continues to be active with three inches of shortening of the femur. The future management of the case is discussed. (CH)

Vertebrates

Refer also to abstracts 24416, 24417, and 24473.

24495 (CONF-7210114-) SOMATIC EFFECTS OF CHRONIC IRRADIATION. Summaries of Papers Delivered at the All-Union Symposium on the Effects of Chronic External Gamma Irradiation on the Dog Organism, Istra, 16–20 October 1972. Burnazyan, A. I.; Grigor'ev, Yu. G.; Markelov, B. A.; Tsessarskaya, T. P.; Shikhodyrov, V. V. (eds). (AN SSSR, Moscow). 1972. Translation of Somaticheskie Effekty Khronicheskogo Oblucheniya, Tezisy Dokladov na Vsesoyuznom Simposiume Khronicheskoe Deystvie Vneshnego Gamma-Oblucheniya na Organizm Sobak, g. Istra, 16–20 Oktyabrya 1972. 130p. Dep. NTIS $8.50.

From symposium on the effects of chronic external gamma irradiation on the dog organism; Istra, USSR (16 Oct 1972).

Summaries are presented of 48 papers that discuss pathological changes in dogs following chronic exposure to external γ irradiation at various doses and dose rates up to 560 rads. Two-hundred and forty-six dogs were exposed to a ^{60}Co source for 22 hours each day for periods of three to five years. Other dogs were exposed to repeated acute irradiation at doses of 42 rads for comparative purposes. Data are included on radioinduced injuries to the cardiovascular, gastrointestinal, hematopoietic, and nervous systems and the liver, kidneys, adrenal glands, and immune reactions. Dose-response relationships for the development of symptoms of the radiation syndrome are reported. It was concluded that chronic low-dose γ irradiation depletes the compensatory-adaptation capabilities and accelerates accumulation of structural changes in organs and tissues as a function of total dose and dose rate. After discontinuing chronic irradiation, a gradual recovery of some indices of injury was noted, but this recovery was slower in dogs exposed to chronic irradiation than in those exposed to repeated acute irradiation. Problems involved in extrapolation of the data to man, and especially to astronauts exposed to chronic irradiation during prolonged space flights, are discussed. (CH)

24496 NINETEEN PARACENTRIC CHROMOSOMAL INVERSIONS IN MICE. Roderick, T. H.; Hawes, N. L. (Jackson Lab., Bar Harbor, ME). Genetics; 76: No. 1, 109-117(Jan 1974).

Using mutagens on sperm and spermatids nineteen chromosomal inversions in mice were produced. The levels of radiation and chemical mutagen used induced inversions in about one per cent of the animals screened. Nine inversions were transmitted through successive generations, and the particular frequency of first meiotic anaphase bridges manifested by each inversion remained constant. The cytological properties of first meiotic anaphases varied considerably among the inversions. Chromosomal locations of five inversions are known. Four of the five are fully viable in homozygous condition. (auth)

24497 TRANSLOCATIONS, THE PREDOMINANT CAUSE OF TOTAL STERILITY IN SONS OF MICE TREATED WITH MUTAGENS. Cacheiro, N. L. A.; Russell, L. B.; Swartout, M. S. (Oak Ridge National Lab., TN). Genetics; 76: No. 1, 73-91(Jan 1974).

Histological and cytological analyses of the testes were carried out in 42 sterile sons of males treated in the spermatozoal or spermatid stage with 250 mg/kg ethyl methanesulfonate (EMS) alone or after prefeeding with butylated hydroxytoluene (BHT); or treated with 200 R x rays. Of the 42 sterile males, 17 had some mature spermatids, nine were blocked at diakinesis, 15 were blocked in pachytene, and one lacked spermatogenic cells altogether, having Sertoli cells only. Mitotic (spermatogonial) metaphases could therefore be analyzed in 41 of the males and meiotic configurations in 26. None of the males showed abnormalities in chromosome number, such as monosomy, trisomy, or mosaicism for either of these conditions. Certain classes of chromosome abnormalities found associated with male sterility in other investigations, namely trisomies, XXY's, and X-autosome translocations, are not expected from treatment of 19A + Y cells when F_1 males are studied. A very high percentage of the sterile males carried translocations. Direct meiotic evidence for this was found in 22 of the animals. In addition, 11 of the 16 that were blocked (or virtually blocked) in pachytene, and thus could be analyzed in mitosis only, consistently showed one abnormally short chromosome (or, one short plus one long), which presumably had resulted from unequal exchange (or sizable deficiency). Of the meiotically detected translocation males, 1 carried a T(A;Y), 17 had single autosomal translocations, and 4 had multiple autosomal rearrangements involving three, four, four, and six breaks, respectively. In addition, three males showed failure of X–Y pairing. Translocations that cause sterility, rather than partial sterility, in males appear to be those in which at least one of the breaks occurs close to one end of a chromosome. The mitotic and meiotic evidences for this were found to be correlated. It is proposed that many cases of induced F_1 male sterility may by the result of position effects produced when paracentromeric regions are translocated to euchromatic regions of certain other chromosomes. Since many translocations that produce partial sterility in the female cause complete sterility in the male, the male must be assumed to be more susceptible to disturbances of fertility by the postulated mechanism. There is evidence that EMS, especially in the lower dose range, more often breaks chromosomes near one of their ends than does x-irradiation. (auth)

24498 DOGS' SURVIVAL FROM INTERNAL IRRADIATION BY ^{210}Po. Parfenov, Yu. D. (Inst. of Biophysics, Moscow). Strahlentherapie; 146: No. 4, 462-468(Oct 1973).

The dogs' median life-span at 14 levels of ^{210}Po administration, ranging from 0.001 to 0.5 μCi/g, was studied. With higher ^{210}Po levels, the median life-span decreased from 359 to 6.1 days. This correlation is best described by the power function and has two phases with different function constants. With the ^{210}Po levels ranging from 0.03 to 0.1 μCi/g, the dogs' death occurs from the equal absorbed doses. The relative life-span shortening per 1 rad of absorbed dose increased for the doses higher than 0.3 μCi/g. The relative life-span shortening per 1 rad/day increased with smaller initial absorbed dose rates. (auth)

24499 RADIOSENSITIVITY OF EHRLICH ASCITES TUMOR CELLS IN DIFFERENT GROWTH PHASES AND ITS ENHANCEMENT BY IODOACETAMIDE. Tanaka, N. (Kyoto Prefectural Univ. of Medicine). J. Radiat. Res.; 14: No. 3, 236-247(Sep 1973).

The x-ray survival curve of Ehrlich ascites tumor cells and its modification by iodoacetamide were determined by the TD_{50} assay. Survival curves for tumor cells of 1-, 6-, and 12-days after transplantation were examined in the presence or in the absence of the agent. The D_0 was 130, 350, or 230 rads for 1-, 6-, and 12-day-old tumor cells, respectively. The response to x-rays of 1- and 6-day-old tumor cells was enhanced by iodoacetamide, while that of 12-day-old or stationary phase tumor cells was hardly enhanced. The increased radiosensitivity and the lowered sensitization by iodoacetamide of 12-day-old tumor cells might be attributed to an increased proportion of the stationary phase cells. (auth)

24500 DETECTION OF PULMONARY IRRADIATION INJURY BY DETERMINING PLASMA LACTIC DEHYDROGENASE (LDH) ACTIVITY. Bloor, C. M.; Leroy, E. P.; Friedman, P. J.; Sobel, B. E. (Univ. of California, San Diego, La Jolla). Radiat. Res.; 57: No. 2, 311-318(Feb 1974).

Under short-acting anesthesia, the right hemithorax of 11 dogs was irradiated with 800 and 1000 to 1200 rads (^{60}Co), and blood samples were taken sequentially for 36 hr. Three other dogs were anesthetized but not irradiated, for controls. The activities of plasma lactic dehydrogenase (LDH) and its isoenzymes were assayed before and after irradiation. The relation between the earliest morphological changes after irradiation and activity changes in LDH_3, which is specific to lung and associated with acute pulmonary injury were studied. There was no significant change in total LDH or LDH_3 activity in either the controls or the group receiving 800 rads. In dogs receiving 1000 to 1200 rads LDH activity was twice that of controls at 2 hr after irradiation ($P < 0.05$), and returned to control by 4 hr. LDH_3 was elevated 15 min after irradiation and rose to three times control by 2 hr ($P < 0.05$). Ultrastructural changes in alveolar and capillary epithelium were found only in this group. Plasma LDH_3 activity may be a useful index to even minimal acute pulmonary irradiation injury. (auth)

24501 INTERSTRAIN VARIATION IN GAMMA-RAY INDUCTION OF HINDLIMB DEFORMITIES IN CHICK EMBRYOS. Kawahara, T. (National Inst. of Genetics, Misima, Japan). Radiat. Res.; 57: No. 2, 332-341(Feb 1974).

Gamma irradiation of eggs at a very early stage of embryonic development produced facial anomalies, and at 48 to 60 hr of incubation induced deformities in the hind- and forelimbs. Strains differed in the frequency and degree of deformities in hindlimbs. Barred Plymouth Rock showed the lowest frequency, and White Leghorn the highest of the three breeds tested. The reciprocal F_1 hybrids between the two breeds, when irradiated, showed that the incidence of deformities could be maternally determined. In the backcrosses, however, the paternal genotype had a strong influence on the incidence. Nagoya breed showed an intermediate incidence between the above two. Its reciprocal F_1 hybrids with White Leghorn showed transgressive matrocliny, and maternal effect was apparent in the backcrosses. The heritability estimate for the frequency of hindlimb deformities was 0.303 on the average. The incidence and the magnitude of hindlimb deformities were highly correlated. The incidence was negatively correlated to the number of somites at 48 hr of incubation, but was uncorrelated with shell thickness. (auth)

24502 EFFECT OF TIME BETWEEN FRACTIONS ON THE RESPONSE OF TUMORS TO IRRADIATION. Howes, A. E.; Suit, H. D. (M. D. Anderson Hospital, Houston, TX). Radiat. Res.; 57: No. 2, 342-348(Feb 1974).

Third-generation isotransplants of a C3H mouse mammary tumor were irradiated with fractionated doses of 250 kV x-rays. All the treatments consisted of five equal doses with the time between each fraction varying from 0 to 5 days. The tumors were irradiated under hypoxic, aerobic, or hyperbaroxic conditions, and response was expressed as the dose required to produce local control in 50% of each treatment group ($TCD_{50/120\ days}$). The results have been interpreted in terms of a cell-survival theory and indicate that extensive repair, repopulation, and reoxygenation take place during the course of treatment. Further, by appropriate spacing of fractions, tumor response can be maximized, the optimal spacing being similar for both aerobic and hyperbaroxic treatments. (auth)

24503 HAPTOGLOBIN LEVELS IN PLASMA OF IRRADIATED MICE. Hayakawa, J. I.; Tsuchiya, T. (National Inst. of Radiological Sciences, Anagawa, Japan). Radiat. Res.; 57: No. 2, 239-245(Feb 1974).

The effects of single-dose whole-body and partial-body irradiation and of continuous irradiation on haptoglobin levels in plasma were evaluated in C57BL/6J mice. The haptoglobin levels reached a maximum at 24 hr after a single whole-body exposure and increased with increases in the radiation dose. After irradiation with 600 R there was a secondary increase at 6 to 7 days. Syngeneic bone marrow cell treatment appeared to enhance the recovery process from the secondary increase. In the case of partial-body irradiation, the increase of haptoglobin was not necessarily correlated with the volume dose of the irradiated parts of the body. Continuous irradiation from ^{137}Cs for 32 weeks at daily doses of 24 R did not have any influence on haptoglobin levels. These results indicate that the haptoglobin levels shortly after an acute irradiation reflect a tissue injury which is not evoked by low dose-rate irradiation, and that the lethal radiation provides a different factor, which evokes a secondary increase of haptoglobin. (auth)

24504 RELATIONS BETWEEN THE RADIOSENSITIVITY OF HIGHER-DEVELOPED ORGANISMS AND THE ADENYLATE-CYCLASE SYSTEM OF THEIR CELLS. Langendorff, H.; Langendorff, M. (Heiligenberg-Institut, Baden, Ger.). Strahlentherapie; 146: No. 4, 436-443(Oct 1973). (In German).

The influence of cyclic adenosine-phosphodiesterase inhibiting substances and of glucagon (alone or in combination with phosphodiesterase inhibitors) on the survival rate of female NMRI-mice, irradiated with lethal doses, was investigated. It was found that both adenine and ATP significantly increased the survival rate of the animals after irradiation with 810 R. In contrast, theophylline had little effect. If adenine or ATP and theophylline were applied, the survival rate depended on the sequence of application before irradiation. Glucagon alone or in combination with theophylline had no effect. The combination of ATP and glucagon brought a higher survival rate, in correlation to the administered dose of glucagon. These findings are considered as a further proof of the fact that the radiosensitivity of the mouse is closely related to the membrane-linked adenylatecyclase system. (auth)

24505 EFFECTS OF IRRADIATION ON EXPERIMENTAL AUTOALLERGIC SIALADENITIS. White, S. C.; Casarett, G. W. (Univ. of Rochester, NY). Radiat. Res.; 57: No. 2, 276-287 (Feb 1974).

The influence of localized irradiation (1000 R) on the time of development and intensity of an immunologically mediated inflammatory lesion was investigated. An experimental autoallergic sialadenitis (EAS) of the rat submandibular gland was developed to serve as the standard lesion. Consistently mild or severe lesions of EAS were induced in male Lewis rats when they were immunized with allogeneic submandibular glands from sexually immature or mature female donors, respectively. Neck irradiation alone 7 to 56 days prior to sacrifice induced only occasional inflammatory lesions in the submandibular glands. The weights of the submandibular glands decreased progressively while the body weights continued to rise. Neck irradiation 7 to 56 days prior to sacrifice of animals immunized 7 to 21 days prior to sacrifice to induce mild or severe EAS did not significantly accelerate development of the lesion nor was the intensity of inflammatory lesions significantly modified. In animals with mild or severe EAS that were neck irradiated, the weights of the submandibular glands decreased while the body weight remained relatively unchanged. Thus, the influences of neck irradiation (1000 R) (primarily a progressive submandibular weight decrease) neither significantly altered nor was altered by the development of the experimental autoallergic lesion of the submandibular gland. (auth)

24506 ^{59}Fe LABELING IN BONE. Thomson, R. A. E.; Corriveau, O. J.; Rubin, P. (Univ. of Rochester, NY). J. Nucl. Med.; 15: No. 3, 161-163(Mar 1974).

Autoradiographs of the tibia of rabbits revealed labeling of osteocytes and/or associated lacunae at 24 hr after the intravenous injection of ^{59}Fe-labeled ferrous citrate. Following x-irradiation of the tibia in eight rabbits, labeling was increased in six instances and decreased in two. Evidence of ^{59}Fe labeling in sites other than marrow in bone is presented. (auth)

Invertebrates

Refer also to abstract 26513.

24507 (INIS-mf-730) EFFECT OF GAMMA RAYS ON MUSCULAR TRICHINAE. Georgieva, D. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 9p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

The effect of gamma rays from ^{60}Co at doses of 1.10^3 to 3.10^4 R on pieces of trichinous pork with dimensions 4/4/1 cm and 20/10/10 cm was studied. It was established that the effect of gamma rays does not depend on the dimensions of the meat pieces irradiated. The invasion capacity of muscular trichinae subjected to irradiation was tested biologically on albino rats. The female intestinal trichinae appeared to be more resistant to the effect of gamma rays than the males. Sexually mature trichinae grown from larvae obtained from irradiated meat were not able to reproduce. Irradiation doses above 9.10^3 R inhibit embryo formation and doses above $1{,}2.10^4$ R interrupt the cycle of development of the muscular trichinae into intestinal forms. (INIS)

24508 (INIS-mf-753) STERILIZING DOSES OF GAMMA IRRADIATION FOR CONTROL OF CERTAIN STOREHOUSE PESTS ON STORED WHEAT GRAIN. Tsvetkov, D.; Savov, D.; Atanasov, Kh.; Berberov, D. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 14p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Tests were carried out for determining the sterilizing doses of ^{137}Cs gamma irradiation by means of "Stebel" ZM irradiator for control of the imaginal and pre-imaginal stages of Sitophilus granarius L., Sitophilus oryza L., Tribolium castaneum Herb., Rhizopertha dominica F. and Plodia interpunctella Hb. The irradiation was given in doses of: 7, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 22, 24, 25, 30, 40, and 60 kR. The sterilizing doses for the separate tests vary in the range of 9 to 25 kR. Doses above 25 kR cause morphological changes in the imaginal stage of Plodia interpunctella Hb. Sitophilus oryza L. appears most sensitive to irradiation while Plodia interpunctella Hb. is most resistant. The irradiation reduces the life duration of the adult insects. The beetles die 15 to 20 days after irradiation. Exception is made only for Rhizopertha dominica F., which lives up to 100 days. (auth)

24509 VARIATION WITH SEX OF IRRADIATED-INDUCED CHROMOSOME DAMAGE IN SOMATIC CELLS OF DROSOPHILA MELANOGASTER. Gatti, M.; Tanzarella, C.; Olivieri, G. (Consiglio Nazionale delle Richerche, Rome). Nature (London); 247: No. 5437, 151-152(18 Jan 1974).

It is stated that although much information has been collected on chromosome mutations in Drosophila melanogaster, as analyzed by genetic methods, there has so far been no cytological analysis of the chromosome mutations induced in somatic cells. In the studies described cells were irradiated, in which it was known that somatic pairing was present, to verify earlier studies on the influence of chromosome pairing on the type and frequency of induced chromosome aberrations. Irradiation was with ~300 to 1250 R of x rays at 125 R/min. The main types of chromosome and chromatid aberrations that could be scored are shown. It was found that in the females there was a greater frequency of aberrations of every type. It is difficult to determine the cause of this difference, but a difference in the efficiency of repair both of premutational damage and of broken chromosomes may be involved. There was almost a total absence of intra-exchanges, both at chromatid and chromosome level, and it is thought that this is one of the effects associated with chromosome pairing. (UK)

24510 STUDY OF THE BIOLOGICAL EFFECTIVENESS OF HIGH-ENERGY ELECTRONS AT ULTRA-HIGH DOSE RATES USING DRY EGGS OF ARTEMIA. Iwasaki, T.; Kato, Y.; Antoku, S. (National Inst. of Radiological Sciences, Anagawa, Japan). Radiat. Res.; 57: No. 2, 195-206(Feb 1974).

Dry Artemia eggs were used to determine the biological effectiveness of a 29-MeV electron beam at depths of 2.3 cm (2×10^8 rads/second), 11.3 cm (1×10^8 rads/second), and 13.0 cm (5×10^7 rads/second) in a water phantom. It appears that a significant difference in effectiveness exists at these three depths as measured by the hatchability and hatching delay of the eggs. The effect at the 11.3- and 13-cm depths is 1.16 and 1.32 times greater than at the 2.3-cm depth. Experiments to determine the effect of dose rates ranging from 1×10^7 to 2×10^8 rads/second at the same depth demonstrated an apparent lower effectiveness of radiation exposure when delivered at extremely high dose rates. From the results of these experiments, it was concluded that the difference in biological effectiveness of 29-MeV electrons at various depths is the result of a dose-rate effect. (auth)

24511 INSECT CONTROL WITH γ RAYS. Simon, E., J. E. (Centro Nacional de Investigaciones Agropecuarias, Lima). pp 337-345 of Genes, Enzymes, and Populations. Srb, A. M. (ed.). New York; Plenum Publishing Corp. (1973).

From 12th international symposium on basic life sciences; Cali, Colombia (27 Nov 1972). See CONF-721102-.

The sterile insect release method (SIRM) for insect pest control with γ radiation uses the insect pest to control itself. It provides the following advantages: where a pest insect is able to live or survive, the sterile insect will duplicate its behavior, therefore, there is no haven for the pest; the insect pest need not reach a high population level, as is necessary before a system such as parasites and predators begins to work; and the sterile insects are able to mate with and decrease the population of only their own kind, thus the system is highly specific. Seven requirements established for its use include: a mass-rearing system must be established, or must at least be possible with current knowledge; the female must mate only once or at most twice during its life cycle; the radiation must cause complete sterility of the insects without decreasing their other biological attributes such as competitiveness; the zone where SIRM is going to be applied must be isolated naturally or artificially; the insect must not cause crop injury at the stage in which it is going to be liberated; the insect population must naturally fluctuate, or, if this fluctuation does not occur naturally, it must be possible to depress the population by use of insecticides or other means; and an intensive knowledge of the insect's habits and ecology must be available, including knowledge of its longevity, where and when copulation occurs, the number of generations a year, flight capacity, sex ratio, and reproductive potential. Mass rearing programs are in effect for several species of Diptera, including the screwworm fly, Ceratitis capita (medfly), and Culex fatigans mosquito. Some others have been raised in lesser amounts, including Glossina morsitans and Glossina tachinoides, two species of tsetse flies; Stomoxys calcitrans, or stable fly; the onion fly, Hylemya antigua; the Oriental fruit fly, Dacus dorsalis; the South American fruit fly, Anastrepha fraterculus; the Mexican fruit fly, Anastrepha ludens; and the Caribbean fruit fly, A. suspensa. Some Lepidoptera are also being reared; these include Cydia pomonella; the corn earworm, Heliothis zea; the tobacco budworm, Heliothis vierscens; the tobacco hornworm, Manduca sexta; and the pink bollworm, Pectinophora gossypiella. Several million of these species are being reared per week, and it is also true with the sugarcane borer, Diatraea saccharalis. Representatives of Coleoptera are also raised in this way; the cotton boll weevil, Anthonomus grandis, is reared in a factory with a capacity of 15 million insects per week. Investigators working with all these species are ready to start, or have already started, projects with the SIRM. Most of the insects are sterilized by ionizing radiation; the boll weevil, however, is sterilized chemically. Data are included on the γ radiation dose required for 99% sterilization of 10 representative insect species. (CH)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 24190 and 24533.

24512 ADVERSE REACTIONS TO RADIO-PHARMACEUTICALS. A Preliminary Survey in the United States. Williams, E. S. (Middlesex Hospital, London). Brit. J. Radiol.; 47: No. 553, 54-59(Jan 1974).

A summary is presented of the results of 40 replies to a questionnaire circulated in 1972 by the Nuclear Medicine Committee of the British Institute of Radiology. A table is presented of the incidence of adverse reactions of patients to radiopharmaceuticals iron precipitate, sulphur colloid, MAA, DTPA, and gold colloid, the tracer being either ^{99m}Tc or ^{113m}In, except in the colloid labeled with ^{198}Au. The results are discussed with relation to the findings of other workers. (UK)

24513 TREATMENT OF METASTATIC CARCINOMA OF THE PROSTATE TO BONE WITH PARATHORMONE AND RADIOACTIVE PHOSPHOROUS. Merrin, C.; Bakshi, S. (Roswell Park Memorial Inst., Buffalo). J. Surg. Oncol.; 6: No. 1, 67-72(1974).

Eight patients with metastases to bone from carcinoma of the prostate were treated with a combination of parathyroid hormone and ^{32}P. Seven of 8 patients reported substantial pain relief ranging from 1 to 8 months in duration. Several chemical parameters were altered during the priming period with parathyroid hormone but no objective response to the combination therapy was observed. (auth)

Animals

24514 (CEA-CONF-2368) HOMEOSTASIS OF THE ALVEOLAR MACROPHAGE POPULATION. Martin, J.; Lafuma, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 – Montrouge (France)). 1973. 7p. (In French). (CONF-730570 – 3). Dep. NTIS (U. S. Sales Only) $3.00

From congress on alveolar macrophage; Lille, France (28 May 1973).

The counting of the intra-alveolar macrophages in the rat using isotopic methods establishes the fact that the population varies with the breed and the sex of the animal and its health. The population varies as a function of these parameters proportionally to the number of cells dividing in the alveolus. Only pathological conditions of alveolar irritation from silica and Pu aerosols, which increase the population, have varied the percentage of cells in synthesis phase. (tr-auth)

24515 (CEA-CONF-2369) STUDY OF THE ALVEOLAR MACROPHAGE AFTER INHALATION OF PLUTONIUM OXIDE. Nolibe, D.; Masse, R. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 – Montrouge (France)). 1973. 7p. (In French). (CONF-730570 – 4). Dep. NTIS (U. S. Sales Only) $3.00.

From congress on alveolar macrophage; Lille, France (28 May 1973).

The alveolar macrophage was studied after inhalation by rabbits and monkeys of insoluble particles of plutonium oxide with a diameter of 0.5μ. The alveolar macrophages were sampled either by postmortem pulmonary lavage or in vivo pulmonary lavage. The results showed that in spite of the radioresistance of the alveolar macrophage its phagocyte capacities and mobility functions were rapidly impaired by the presence of plutonium oxide. The results of these effects is the blocking of the alveolar purification. The blocking leads to the accumulation of intra-alveolar cells. Cytolysis stimulates the migrating cells, which leads to an increase of the population. The migration of the cells toward the interstitium seems weak during the first month. This makes it possible to eliminate more than 65% of the inhaled dose by pulmonary lavage in vivo. (tr-auth)

24516 (UR-3490-383) BIOLOGICAL EFFECTS OF THE RADIOACTIVE NOBLE GASES. Morken, D. A. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics). 1973. Contract AT(11-1)-3490. 13p. (CONF-730915-12). Dep. NTIS $3.00.

From symposium on noble gases; Las Vegas, Nevada, USA (24 Sep 1973).

The biological effects of inhaled ^{85}Kr, a β emitter, and ^{222}Rn, an α emitter, in experimental mammals are similar at the acute lethal level to each other and those from external x or γ irradiation. Work with krypton has just begun. Radon has been studied more extensively in terms of mortality, body weight, and the hemogram. In general the effects are not different from those found with x or γ radiation. Radon produces a few specific differences from x or γ irradiation. Red cell forming tissue is only slightly injured although the other blood cell forming tissues respond in the expected manner. The growth pattern is altered, with permanent stunting a result. These specific effects may be a result of a special kind of injury which the α particle can produce. Similar experiments with β particles from ^{85}Kr may resolve this difference and may lead to a better understanding of the nature of these effects. (auth)

24517 EFFECTS OF CONTINUOUSLY ADMINISTERED ^{90}Sr AND ^{137}Cs ON MICE. 9. Weights of Thymus and Spleen Related to Aging of Mice. Nishio, K. (Radiation Center of Osaka Prefecture, Sakai, Japan). Annu. Rep. Radiat. Center Osaka Prefect.; 13: 121-123(Mar 1973).

Weight change of thymus and spleen of mice administered continuously with ^{90}Sr and ^{137}Cs was observed in relation to reproduction-span and incidence of leukemia. Strontium-90 and ^{137}Cs were administered through drinking water, and the propagation was done by brother-and-sister mating. The levels of water contamination were 0.1 μCi of ^{90}Sr and 0.4 μCi of ^{137}Cs per ml in group-1, as 1/10 respectively as group-I in group-II, and as 1/100 respectively as group-I in group-III. Experimental mice belonged to generation from the 3rd to 9th. Control was named group-IV. Decrease of thymus weight in female mice are parallel to decrease of reproductive function (litter size per birth) in all groups. It is noticeable especially in group-III that thymus weight is on higher level than group-IV at 400 days of age in agreement with not yet disappeared reproductive function while thymus weight is lighter as well as litter size is smaller then IV at 300 days. The delay to older age in age of first and last birth as well as in atrophy of thymus in female of III would be due to breaking of aging. Decrease of spleen weight related to age is quite simple in IV, but very complicated in inner-irradiated groups. The highest induction to leukemia and the highest level of spleen weight are observed in females of I. This correlation suggests that hard compensative hypertrophy of spleen against blood or spleen cell damage might induce leukemia. (auth)

24518 RADIOLOGICAL STUDIES ON THYMUS AND SPLEEN IN SWISS ALBINO MICE AFTER ADMINISTRATION OF RADIOPHOSPHORUS (^{32}P). Kumar, A.; Srivastava, P. N. (Rajasthan Univ., Jaipur, India). Strahlentherapie; 146: No. 4, 473-477(Oct 1973).

Adult Swiss albino mice were injected with carrier-free radiophosphorus (^{32}P) at a dose of 2.0 μCi/g body weight. The animals were autopsied at the intervals of 1 and 3 days and 1, 2, and 4 weeks after ^{32}P administration. The thymus and spleen show reduction in the number of lymphocytes. The maximum damage was observed at 3 days post-injection interval. The lymphocytes show pyknotic and chromatolytic nuclei. The reparation in thymus and spleen starts after one week and is more or less complete after four weeks. (auth)

24519 COMMENTARY: RADIOACTIVE WASTES AND DAMAGE TO MARINE COMMUNITIES. Wallace, B. (Cornell Univ., Ithaca, NY). Bioscience; 24: No. 3, 164-167(Mar 1974).

The long-term effects of the marine disposal of radioactive wastes and thermal effluents from nuclear power plants on the ecological communities of estuaries and coastal waters are postulated. Methods for measuring population fitness in relation to dynamic cycling and the relationship of radioinduced mutations to population dynamics are reviewed. The need for laboratory and field studies to evaluate the effects of radiation on marine communities is emphasized. (CH)

24520 DAMAGE OF RAT THYROID BY ^{131}I AND EVIDENCE AGAINST IMMUNOLOGIC TRANSFERABILITY. White, S. C.; Casarett, G. W. (Univ. of Rochester, NY). Radiat. Res.; 57: No. 2, 288-299(Feb 1974).

Young adult male rats given single injections of ^{131}I (100, 300, or 500 μCi) or multiple injections of ^{131}I (33 or 167 μCi weekly for 3 weeks) were studied periodically for up to 8 weeks for thyroid histopathology and evidence of immunologic transferability of radiation-induced thyroid lesions. The single injections of 300 or 500 μCi initiated an early acute inflammatory response in the thyroid gland. By 8 weeks extensive parenchymal degeneration was evident. After the dose of 100 μCi ^{131}I an effect was seen at 8 weeks when a mild diffuse degeneration was evident. Fractionation of the 500-μCi injection (into three weekly injections of 167 μCi) resulted in only moderate parenchymal degeneration and more uniform destruction of thyroid tissue. Passive transfer of serum and/or lymphoid cells from ^{131}I-treated donors to non-treated young adult male rats failed to demonstrate transferability of the lesion. (auth)

24521 VERY RAPID ENHANCEMENT BY D_2O OF THE TEMPERATURE-TOLERANCE OF ADULT DROSOPHILA. Pittendrigh, C. S.; Cosbey, E. S. (Stanford Univ., CA). Proc. Nat. Acad. Sci. U. S. A.; 71: No. 2, 540-543(Feb 1974).

Deuterium oxide, D_2O, increases the temperature-tolerance of Drosophila pseudoobscura when it is administered to adult flies as a sucrose solution. The effect is very rapidly exerted; it is detected within 10 min after the flies have a brief (10 min) opportunity to drink. This increased resistance to heat-death surely implies an increased resistance of macromolecules to thermal denaturation. D_2O is known to exert such an effect on in vitro protein solutions. The speed with which the increased stability develops clearly implicates a solvent action of D_2O, and is most easily understood if the effect is traceable to enhancement of the hydrophobic interactions which contribute to conformational stability. The increased strength of deuterated hydrogen bonds cannot be excluded however. The possible bearing of these results on the hypothesis that D_2O always increases the period of circadian oscillations by "diminishing the apparent temperature" is briefly considered. (auth)

Nuclide Kinetics and Toxicology

Man

Refer also to abstract 24198.

24522 (EUR-4964) IODINE METABOLISM IN CHILDREN AND ADOLESCENTS IN A REGION OF THE EEC. Karhausen, L.; Pages, J. P.; Piepz, A.; de Visscher, M. (Commission of the European Communities, Luxembourg). [nd]. 16p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

24523 (INIS-mf-911, pp 69-71) MYOCARDIAL SCANNING: REPORT ON CLINICAL EVALUATION TO DATE. Barr, L; Baron, J. (Central Emek Hospital, Afula, Israel). 1973.

A method for scanning of the myocardium using ^{131}Cs and a rectilinear scanner, have been developed and, for the past 18 months, also clinically evaluated. The procedure, which involves no patient discomfort and is safe, gives information on the regional arterial perfusion of the myocardium which is an important parameter in the investigation of patients with acute myocardial infarction (A. M. I.). Results were encouraging and the examination shows promise as a screening method in the determination of the further management of the patient. It was found that it is particularly useful in the assessment of patients with suspected left ventricular aneurisms (L. V. A.) and this presentation concentrates on this aspect and reports on the results in this group of patients. (INIS)

24524 (UCRL-Trans-1512) STUDY OF THE MEDULLARY CIRCULATION IN MAN BY AN ISOTOPIC TECHNIQUE. Najean, Y.; Clement, F. Translated by H. G. Parker from Nouv. Rev. Fr. Hematol.; 3: No. 2, 133-138(1963). 6p. Dep. NTIS $3.00.

After intra-medullary injection of 51Cr-labeled sodium chromate to patients, there were two phases in the appearance of radioactivity in the blood at the periphery. The second is exponential and appeared to correspond with the period of diffusion and of equilibration between the substance injected and the vascular space. This did not vary in the pathological conditions studied (acute leukemia, hemolytic anemia, and myeloid metaplasia). The first phase was very rapid and appeared to correspond with the direct intravascular introduction of the tracer: It therefore gives some indication of the medullary blood flow, which was greatly diminished in post-radiotherapy myeloid neurosis. (auth)

24525 (UR-3490-393) LOCALIZATION OF ^{131}I ANTIBODY TO HUMAN FIBRINOGEN IN RHEUMATOID ARTHRITIS. Spar, I. L.; Ciccio, S. S.; Jacox, R. F.; Farrer, P. A.; Greenhouse, V. Y.; Fisher, M. S. (Rochester Univ., N. Y. (USA)). [nd]. 13p. (CONF-740203-6). Dep. NTIS $3.00.

From international symposium on radiopharmaceuticals; Atlanta, Georgia, USA (12 Feb 1974).

Attempts were made with several different radioactive preparations to locate inflammation in joints of patients with rheumatoid arthritis. Since one of the inflammatory events is deposition of fibrinogen as fibrin, it seemed reasonable to see if ^{131}I antibodies to human fibrinogen could be used as a tool to locate the actual areas of inflammation in affected knees of patients with rheumatoid arthritis. The patients were first given ^{131}I human serum albumin (RISA) and were scanned 1, 4, and 7 days later. RISA was chosen since its biological half-life is close to that of RIAF. Several weeks later they were given ^{131}I antibodies to human fibrinogen (RIAF) and studied again at 1, 4, and 7 days. (auth)

24526 CONTROL OF THE INHALED FRACTION OF RADIOACTIVE AEROSOL PARTICLES. Zalmanzon, Yu. E.; Chutkin, O. A. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 21, 34-39(1973). (In Russian).

The basis, construction, and experimentally determined characteristics of the aerosol preprecipitator are reported. The results of the study of the inhaled fraction of ^{239}Pu aerosols in a hot laboratory are described. (tr-auth)

24527 COEFFICIENT OF RETENTION OF RADIOACTIVE AEROSOLS IN RESPIRATORY ORGANS. Zalmanzon, Yu. E.; Chutkin, O. A. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 21, 29-33(1973). (In Russian).

Calculations of the coefficient of retention of radioactive aerosols in three parts of the human respiratory track are reported for a wide range of degree of dispersion of the aerosol particles, respiration characteristics, and other magnitudes. It is shown that as a result of the calculation of the internal radiation dose from a given standard of the radioactive aerosol concentration there is a large uncertainty in individual cases. (tr-auth)

24528 DEVICE SIMULATING THE RESPIRATORY TRACK OF MAN. Zalmanzon, Yu. E.; Sidorov, V. V.; Chutkin, O. A. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 21, 25-28(1973). (In Russian).

The design and operational principles used in the preparation and use of a model of the human respiratory track for differential measurement of the precipitation of aerosols are described. Experimental values of the passage of radioactive aerosols through the model of the tracheo-bronchial track, obtained by two independent methods, agree satisfactorily with each other and with calculated values. (tr-auth)

24529 HYPOTHYRODISM SECONDARY TO RADIOIODOTHERAPY. Micultia, M.; Derevenco, V.; Holan, P. Stud. Cercet. Endocrinol.; 23: No. 4, 263-269(1972).

In the years 1960 to 1969 1050 hyperthyroid patients were treated most of which (57 cases i.e., 66%) showed well-compensated oligosymptomatic forms that required no corrective treatment. Twenty-nine patients presented evident clinical signs of hypothyroidism, checked also through radioisotopic tests, but only in some of these edema occurred. The results obtained seem to justify the administration of low and average doses of radioactive iodine, and rigorous individualization of treatment in respect to thyroid size and the clinical form of the disease. In view of preventing severe forms and prescribing an adequate treatment a close cooperation between patient and physician is needed, as well as hospitalization of audioiodine treatment patients. (Rom. Sci. Abstr.)

24530 MEASUREMENT OF ^{226}Ra BODY BURDEN OF A JAPANESE WHO WAS A RADIUM WORKER BETWEEN 1934 AND 1960. Anzai, I. (Tokyo Univ.); Izumi, K. Radioisotopes (Tokyo); 22: No. 8, 453-454(Aug 1973).

24531 ^{59}Fe WHOLE-BODY COUNTING IN NORMAL, ANCYLOSTOMA AND SICKLE CELL ANAEMIA CASES IN THE REPUBLIC OF ZAIRE. Hashish, S.; Ditu, S.; Ntundulu, T. (Nuclear TRICO Centre, Kinshasa, Zaire). Isotope Radiat. Res.; 6: No. 1, 31-39(Jun 1973).

Whole-body counting was performed on a number of normal, ancylostoma, and sickle cell anaemia cases for a period of one month following an intravenous dose of ^{59}Fe citrate. The counting set-up is described and the problems encountered for whole-body counting and interpretation of results are discussed. The whole-body activity has not significantly changed in the normal and sickle anaemia cases, while it has declined gradually in the ancylostoma cases. The whole-body and the corresponding blood activity figures are compared. The data and findings are discussed in the light of relevant literature. (auth)

24532 LONG-TERM STUDIES OF IRON METABOLISM IN NORMAL MALES: COMPARISON OF RED BLOOD CELL RADIOACTIVITY WITH WHOLE-BODY COUNTER DATA. McKee, L. C. Jr.; Price, R.; Johnston, R. E.; Heyssel, R. M.; Johnson, L. E.; Brill, A. B. (Vanderbilt Univ., Nashville). J. Nucl. Med.; 15: No. 3, 156-160(Mar 1974).

Iron metabolism was studied in normal adult males measuring ^{59}Fe in the body by a whole-body counter technique and ^{55}Fe in red blood cells. The whole-body counter studies reveal that radioiron counts decreased as a single exponential with a biological half-life between 640 and 6,500 days. Studies of ^{55}Fe within circulating red cells revealed that the counting rate fluctuated greatly in a pattern compatible with normal red cell survival. The radioiron concentration never stabilized, suggesting that equilibration between radioiron and stable iron did not occur in a period of up to 1,400 days. Since equilibration must be assumed for mathematical analysis, accurate estimates of daily loss of iron cannot be made from whole-body data and red blood cell radioactivity, although the loss must be minimal and slow. (auth)

24533 USE OF ^{99m}Tc-SULFUR COLLOID TO ASSESS THE DISTRIBUTION OF ^{32}P-CHROMIC PHOSPHATE. Tully, T. E.; Goldberg, M. E.; Loken, M. K. (Univ. of Minnesota, Minneapolis). J. Nucl. Med.; 15: No. 3, 190-191(Mar 1974).

The use of ^{32}P-chromic phosphate in glucose suspension for intracavitary radiotherapy is complicated by the fact that the distribution of the particulate suspension after installation is unknown. The simultaneous administration of ^{99m}Tc-sulfur colloid with the radiopharmaceutical followed by imaging of the appropriate cavity will depict accurately the distribution of the injected colloid. If one assumes that the two agents initially will occupy the same space and are distributed in a similar fashion, an estimation of the distribution of chromic phosphate is possible. (auth)

Animals

Refer also to abstracts 24506, 24515, 24559, and 26511.

24534 (INIS-mf-722) EFFECT OF CERTAIN HORMONES ON THE INCLUSION OF ^{32}P IN THE PHOSPHOLIPIDS OF THE INTESTINAL MUCOSA. I. The Role of Insulin. Lazarov, I.; Aleksandrov, St. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 13p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

An experiment was carried out with 20 broilers age 2 to 2.5 months. Seven of them were used as controls; 6 were treated in the course of 3 days consecutively with insulin at a rate of 3 ME/kg live weight; the remaining 7 chickens were treated with 250 mg alloxan/kg live weight. In the bilaterally isolated jeunum, with 20 cm length of the segment, were introduced 20 millicurie/kg live weight of KH^{32}PO$_4$. Two hours later the isolated intestinal segment was removed and the lipids were extracted from the mucosa by means of chloroform-methanol (2:1). The separate phospholipid fractions were divided by thin layer chromatography, on silica gel G and after developing them by means of iodine vapors the spots were scraped in separate pots. The radioactivity was measured with the aid of a Geiger-Mueller counter. The total phospholipids were counted from the lipid extract from which two samples were prepared of 0.3 ml each. For higher accuracy two parallel chromatograms were prepared. The blood sugar level was also determined after treatment with insulin and alloxan. The data obtained show that: the insulin certainly ($P < 0.001$) raises the level of the total phospholipids in the jeunum mucosa of the chickens. A certain trend was observed of reducing the inclusion of ^{32}P in the total phospholipids under the effect of alloxan. A reverse correlation was established between the sugar content in the blood and the level of the total phospholipids. The highest rate of inclusion of ^{32}P under the effect of insulin was observed in the lecithin ($P < 0.001$), followed by sphingomyelin ($P < 0.002$), lysolecithin ($P < 0.10$) and cephalin ($P < 0.002$). The cardiolipin is without essential changes. The reduction of the phospholipids under the effect of alloxan is mainly on account of the lysolecithin while cardiolipin remains unchanged. (auth)

24535 (INIS-mf-723) METABOLISM OF ^{75}Se IN THE BODY OF GROWING CHICKENS. Stanchev, Kh. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 18p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

In a series of three tests the metabolism of ^{75}Se was studied as well as the effect of addition of different levels of vitamin E and selenium dioxide on the same. In the chickens 4 millicurie ^{75}Se/kg live weight was administered orally in the form of Na_2SeO_3 and blood was taken from the wing vein at predetermined intervals. The liver, kidneys, pancreas, muscles, brain, spleen, testis, and bones were investigated for radioactivity. The amount of ^{75}Se excreted in the feces and urine was investigated in the 24th, 48th, and 72nd hour after the administration of radioselenium. The resorption of radioselenium in the alimentary system of the chickens was most intensive between the 4th and 7th hour, after which it decreased. The highest rate of ^{75}Se accumulation was observed in the liver and kidneys between the 2nd and 4th and between the 5th and 7th hour respectively. The highest radioactivity was observed in the muscles. The addition of 20, 60, and 200 IU Vitamin E to the basic ration did not cause noticeable alteration of the radioactivity of the blood, the organs investigated and of the excreted ^{75}Se with the feces and urine as compared to the control group. The blood radioactivity decreased with the increase of the amount of selenium in the basic ration, as its lowest level was observed in the group with highest dose of selenium dioxide (6 mg/kg fodder). (auth)

24536 (INIS-mf-724) ASSIMILATION OF ^{32}P FROM MONO-SODIUM AND DICALCIUM PHOSPHATE IN PIGS. Simeonov, S.; Vrigasov, A.; Gromkov, N. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 14p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Experiments were conducted with seven pigs divided into two groups. To one of the groups of three pigs was administered orally a single time radioactive mono-sodium phosphate and to the other group of four pigs, radioactive dicalcium phosphate (^{32}P labelled). The pigs of the two groups received 20 microcurie per kg live weight each. ^{32}P excreted with the feces and urine as well as its deposition in the different tissues and organs of the body 3, 6, and 9 days after its administration in the pigs was determined. It was established that during the first 3 days the percentage of ^{32}P in the pigs was higher in animals treated with mono-sodium phosphate. During the following 3 and 9 days, however, the percentage of ^{32}P content was higher in pigs treated with dicalcium phosphate. In both cases the differences are not big. (auth)

24537 (INIS-mf-725) ASSIMILATION OF ^{32}P FROM MONO-SODIUM PHOSPHATE IN LAYING HENS. Simeonov, S.; Vrigasov, A.; Gromkov, N. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 9p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Experiments were carried out with 8 hens divided into 3 groups in which internally was introduced a single dose of radioactive mono-sodium phosphate (labelled ^{32}P) at a dose of 2 microcurie/kg live weight. The hens of the first group were killed after three days; the second group after six days, and the third group after nine days from the introduction of the isotope. ^{32}P excreted with the feces, urine, and deposition in the eggs as well as its deposition in the different organs was determined. It was established that ^{32}P was excreted mainly with the feces with a maximum rate during the first 24 to 48 hours. The amount of radioactive phosphorus retained in the body of the hens was 84.18% after 3 days, 68.29% after 6 days, and 67.67% after 9 days and was deposited in the different organs as follows: bone skeleton, 25.20%, 18.27% and 27.15%; stomach and intestines 1.56%, 0.86% and 0.93%;

liver 0.66%, 0.51% and 0.55%; cerebrum 0.02%, 0.06% and 0.08%; spleen 0.06%, 0.02% and 0.01%; in other organs 58.66%, 48.57% and 38.97%. The phosphorus in the eggs was deposited mainly in the yolk, to a lesser extent in the white, and the least in the eggshell. (auth)

24538 (INIS-mf-887, pp 189-195) PROBLEMS OF MIGRATION AND METABOLISM OF CARBON-14. Zapol'skaya, N. A.; Pavlitskaya, E. D.; Fedorova, A. V. (Leningradskij Nauchno-Issledovatel'skij Institut Radiatsionnoj Gigieny MZ PSFSR, USSR). [nd]. (In Russian).

In an effort to establish the absorbed doses and the biological radiation effects of ^{14}C, results are presented of quantitative investigations of the ^{14}C migration in the food chain. Investigated were the transport of the radionuclide in the organism with animal foodstuffs and its retention rate in small laboratory animals, such as rats. Activities were calculated related to the effect of ^{14}C ingested with animal foodstuffs on man. (INIS)

24539 AFFINITY OF A MALIGNANT TUMOR AND ORGANS FOR ELEMENTS IN GROUP V OF THE PERIODIC TABLE. Ando, A. (Kanazawa Univ., Japan); Hisada, K. I. Radioisotopes (Tokyo); 22: No. 6, 286-290(Jun 1973). (In Japanese).

In order to investigate the tumor affinity radioisotopes, vanadium (^{48}V), niobium (^{95}Nb), tantalum (^{182}Ta), arsenic (^{74}As) and antimony (^{124}Sb) were examined, using rats that were subcutaneously transplanted with Yoshida sarcoma. Six preparations, ^{48}VO$_2$Cl, ^{95}Nb-oxalate, ^{182}Ta-oxalate, Na$_2$H^{74}AsO$_4$ (Na$_2$HAsO$_4$ 0.008 μg), Na$_2$HAsO$_4$ (Na$_2$HAsO$_4$ 1 mg), and ^{124}Sb-chloride, were injected intravenously to each group of tumor bearing rats. These rats were sacrificed at various periods after injection of each preparation: 3 hours, 24 hours, and 48 hours in all preparations. The radioactivities of the tumor, blood, muscle, liver, kidney, and spleen were measured by a well-type scintillation counter, and retention values in every tissue including the tumor were calculated (in percent of administered dose per g-tissue weight). Niobium-95-oxalate had considerably stronger affinity for the malignant tumor. Vanadium-45-O$_2$Cl, ^{182}Ta-oxalate, Na$_2$H^{74}AsO$_4$ and ^{124}Sb-chloride did not have any affinity for the malignant tumor. But ^{48}VO$_2$Cl had fairly strong affinity for the kidney, Na$_2$H^{74}AsO$_4$ had very strong affinity for blood-corpuscles and strong affinity for the spleen. Tantalum-182-oxalate and ^{124}Sb-chloride did not have any affinity for the organs and ^{182}Ta-oxalate was slowly excreted and ^{124}Sb-chloride was rapidly excreted in urine. (auth)

24540 COMPARISON BETWEEN ^{169}Yb-CITRATE AND OTHER TUMOR SCANNING AGENTS. Ando, A. (Kanazawa Univ., Japan); Hisada, K.; Hiraki, T.; Ando, I. Radioisotopes (Tokyo); 22: No. 8, 415-421(Aug 1973). (In Japanese).

The tumor affinity of ^{169}Yb-citrate, ^{67}Ga-citrate, ^{111}In-citrate, and ^{57}Co-bleomycin was examined by using Yoshida sarcoma-bearing rats, and inflammation affinity of these compounds was also tested by rats with inflammation induced by croton oil injection. In our experiments, ^{111}In-citrate showed inferior value as the tumor scanning agent compared to ^{67}Ga-citrate. ^{57}Co-bleomycin had excellent biological characteristics as the tumor scanning agent, but physical half life of cobalt-57 is too long for this purpose. So it is desirable that bleomycin is labeled with the nuclide that has excellent properties for the medical use. All compounds except ^{111}In-citrate had relatively strong affinity to the inflammation tissue. Values of the concentration ratio of these compounds between tumor and inflammatory tissue were 2.1 to 2.2 at 24 hrs after intravenous injection. The difference of their in vivo distribution between ^{169}Yb-citrate, ^{67}Ga-citrate, and ^{111}In-citrate was investigated in order to use these compounds more properly as the tumor scanning agent. In this investigation, there was no great difference of the uptake in the tumor tissue between these compounds. But great difference in the biological properties of these compounds was observed about the retention value in the blood and the uptake rate in the bone. ^{169}Yb-citrate was rapidly cleared from the blood and was taken mostly in to the bone. So the retention values in the soft tissues became very small. On the other hand, ^{111}In-citrate was slowly and slightly taken in to the bone from the blood, so the retention values in the soft tissues was remaining relatively high. ^{67}Ga-citrate showed the intermediate value of bone uptake rate between ^{169}Yb-citrate and ^{111}In-citrate. (auth)

24541 ACCUMULATION OF GALLIUM-67 AND CALCIUM-45 IN EHRLICH ASCITES TUMOR CELLS. Anghileri, L. J. (Klinikum, Essen). Int. J. Nucl. Med. Biol.; 1: No. 2, 93-95(Nov 1973).

Mice with a 7 day growth of Ehrlich ascites tumor were injected peritoneally with 10 μCi of a carrier-free solution of ^{67}Ga citrate and also with 10 μCi of a ^{45}CaCl$_2$ solution (10 to 25 mCi/mg Ca). Groups of six animals were killed at 6, 24, 48, and 72 hrs after injection and various fractions from the ascitic fluid were assayed for ^{67}Ga and ^{45}Ca content by gamma spectrophotometry and liquid scintillation. The incorporation of ^{67}Ga increased with time elapsed after injection in opposition with the decrease of ^{45}Ca in the 48 and 72 hr samples. Gallium-67 was predominantly found in the fraction insoluble in NaCl, while ^{45}Ca was found mostly in the soluble fraction. Most of the ^{67}Ga could be further extracted with EDTA and TCA. No direct relationship was observed between the amount of radionuclide found in each fraction and the respective protein content. The phospholipid content of the 48 and 72 hr samples appeared to show a slight increase while the nucleic acids tended to decrease. The results are presented in outline and discussed with those of other workers in relation to a link between ^{67}Ga uptake and Ca metabolism. (UK)

24542 ASPECTS OF ^{85}Sr UPTAKE FROM VARIOUS CHEMICAL COMBINATIONS IN RAT SKELETON. Weissbuch, H.; Leporda, G.; Diaconescu, C.; Singereanu, O.; Cotrau, C. Igiena (Bucharest); 21: No. 7, 421-424(1972).

Male Wistar rats averaging 210 ± 5 g each were orally given ^{85}Sr chloride, lactate, and carbonate; the animals were divided into groups of 10 animals and sacrificed at 4 hrs, 24 hrs, and 10 days after administration of the substance. Radiostrontium was assayed in the plasma, gastrointestinal tract, feces, and skeleton. A statistically significant correlation was found between ^{85}Sr amounts taken up in the skeleton and the form of administration (36.2% for chloride, 29.2% for lactate and 20% for carbonate); in the first 24 hrs, Sr lactate was better taken up than Sr chloride, but the former was heavily eliminated in the feces. Early deposition in the bones occurred and the level in bone tissues rapidly exceeded that of the plasma. Clearance formulas are exponential, viz, a rapidly falling component, in terms of the form of administration, and a slow component. (Rom. Sci. Abstr.)

24543 FETAL RAT UTILIZATION OF ^{55}Fe ABSORBED BY FETAL INTESTINE FROM SWALLOWED AMNIOTIC FLUID. Orlic, D.; Lev, R.; Rosenthal, W. S. (New York Medical Coll., Valhalla). Blood; 43: No. 3, 429-436(Mar 1974).

Radioiron (^{55}Fe) injected directly into the amniotic cavity of 21-day rat fetuses is swallowed and rapidly absorbed by the intestine. The radioisotope is then transported from the intestine and is utilized in the liver and spleen, fetal erythropoietic, and iron-storing organs. The level of incorporation in intestine, spleen, and liver, as measured by scintillation counting, is relatively low during the first hour, but increases 3 and 6 hr postinjection. Radioautograms at 6 hr demonstrate extensive labeling in the cytoplasm of absorptive cells in the intestinal mucosa. In liver the ^{55}Fe is observed in parenchymal and reticuloendothelial cells and in developing red cells. Erythroid cells are the principal ^{55}Fe-labeled cells in the spleen. Recirculation of some ^{55}Fe occurred between ^{55}Fe-injected fetuses, maternal organs, and control fetuses. Fetal swallowing of ^{55}Fe within amniotic fluid followed by intestinal absorption of the radioisotope demonstrates the existence of a pathway by which nutrients can be delivered to the fetus. This finding is of potential benefit to the human fetus since a number of compounds, including certain drugs, may possibly be administered via this route. (auth)

24544 ALTERATIONS IN TISSUE DISTRIBUTION OF ^{99m}Tc-PERTECHNETATE IN RATS GIVEN STANNOUS TIN. McRae, J.; Sugar, R. M.; Shipley, B.; Hook, G. R. (Univ. of California, Berkeley). J. Nucl. Med.; 15: No. 3, 151-155(Mar 1974).

A dose of 8 mg Sn(II)/kg produces significant mortality and gross kidney damage in the rat. The tissue distribution of ^{99m}Tc-pertechnetate is altered in rats that have previously received Sn(II). Minimal changes are noted with a dose of 0.02 mg Sn(II)/kg. It should be noted that most kits for human use contain less than 1 mg of Sn(II) per kit and result in a dose less than 0.007 mg Sn(II)/kg. Changes are still present 13 weeks after a dose of 8 mg Sn(II)/kg. It is apparent that the effects of Sn(II) on ^{99m}Tc-pertechnetate are not limited to in vitro reaction. The alterations in tissue distribution of ^{99m}Tc-pertechnetate are most likely due to the chemical reduction and fixation of the ^{99m}Tc-pertechnetate to tissue components due to the continuing presence of Sn(II) in vivo. (auth)

Plants

Refer also to abstracts 24561 and 26509.

24545 (INIS-mf-709) INVESTIGATIONS ON THE EXCRETION OF ^{14}C BY SCENEDESMUS ACUTUS IN NUTRIENT MEDIUM DEPENDING ON THE GROWTH PHASES AND CULTIVATION CONDITIONS. Georgiev, D.; Dilov, Kh.; Avramova, S. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 10p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

In a suspension of algae ^{14}C was added in the form of NaHC^{14}O$_3$. It was ascertained that the photosynthetic fixation of ^{14}C was most intensive in young cells; it decreased with their growth and became lowest prior to cell division. The process of excretion of the radioactive carbon from the cells was analogous but the percentage of the ^{14}C excreted was highest in the middle of the growing season. The absorption of ^{14}C increased with the rise of pH from 3 to 7 and decreased with further rise of pH up to 9. The curve of carbon excretion from the cells was similar to that of the absorption as the absorption maximum was shifted in the direction of the highest pH values, and the percentage of the excreted ^{14}C with respect to the absorbed ^{14}C increased with the pH of the medium. During exposure in the radioactive nutrient medium the photosynthetic fixation of the radioactive carbon was practically equal at different concentrations of the medium salts. The higher the concentration of the salts in the medium the stronger the excretion of ^{14}C was manifested. (auth)

24546 (INIS-mf-711) INTENSITY OF PENETRATION AND INCLUSION OF ^{32}P IN DIFFERENT METABOLIC FRACTIONS OF THE VINE. Popov, T.; Manolov, P.; Krysteva, Z. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 11p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Investigations were carried out with plants of the Kaberne Savignion vine varieties grown on Chesnokov and Bazirina nutritive solution. Phosphorus-32 in six fractions was studied: ortho-phosphate, soluble phosphates in organic acids, phospholipids, ribonucleic acid, desoxyribonucleic acid, and phosphoproteides. The percentage distribution of the fractions was determined in leaf samples from three levels along the length of the shoots, 4, 24, 72, and 120 hours after dressing with radioactive phosphorus with an activity of 1 millicurie per liter. The test shows that ^{32}P penetrates first in the leaves of the lower levels of the shoot and gradually moves towards the upper levels where later its content is highest. The phosphorus is absorbed most rapidly in the acid soluble fraction. In the course of time, however, the isotope percentage in this fraction decreases on account of the relative increase of the labelled phospholipids, nucleic acid, and phosphoproteides. ^{32}P is included in the nucleic acids comparatively later, but its amount in them increases most intensively. This is particularly clearly manifested in the upper level of the shoots where the leaves are in a period of intensive growth. (auth)

24547 (INIS-mf-714) EFFECT OF GIBBERELLIC ACID ON THE INCORPORATION OF ^{32}P IN CERTAIN GROUPS OF PHOSPHORUS COMPOUNDS. Khristov, Kh.; Stamenova, M. (Komitet za Mirno Izpolzuvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 20p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

Seedlings of Salvia were grown in dark and light and treated with gibberellic acid. The inclusion of labelled phosphorus in the acid soluble phosphorus compounds, phospholipids, nucleic acid, and in the phosphoproteins was determined in the hypocotyls of 5 and 7 day old sprouts. It was established that the inclusion of labelled phosphorus in the different groups of phosphorus compounds was stimulated under the effect of the gibberellic acid when the seedlings were grown in light. On seedlings grown in dark the gibberellic acid exerts certain inhibiting effects on the incorporation of ^{32}P in the phosphorus compounds. The effect of gibberellic acid on the growth of the hypocotyls and the utilization of the reserves of the cotyledons at growing sprouts at continuous illumination or darkness are discussed. (auth)

Microorganisms

24548 EFFECT OF OSMOTIC STABILIZERS ON $^{14}CO_2$ PRODUCTION BY BACTERIA AND BLOOD. Zwarun, A. A. (Johnston Labs., Inc., Cockeysville, MD). Appl. Microbiol.; 25: No. 4, 589-591(Apr 1973).

Evolution of $^{14}CO_2$ by whole blood as well as by Diplococcus pneumoniae, Haemophilus sp., Pseudomonas aeruginosa, Pseudomonas diminuta, and Streptococcus pyogenes was examined by using the BACTEC system. The control medium was JLI no. 6A culture vial containing 30 ml of enriched tryptic soy broth and 1.5 μCi of ^{14}C-substrate. Hypertonic media consisted of control medium with either 1 or 3% NaCl, 10% sucrose, and 5%, 10%, or 15% dextran. The most deleterious treatment to bacteria was 3% NaCl since it not only retarded $^{14}CO_2$ production, but also prevented growth of D. pneumoniae, Haemophilus, and P. diminuta. The 10% sucrose treatment diminished $^{14}CO_2$ output, although it did not retard growth of test organisms. This effect was probably due to ^{14}C-substrate dilution rather than to osmotic effects. Dextran had slight effect on $^{14}CO_2$ production and slightly acidified the medium. Of the treatments tested, only 10% sucrose reduced normal output of $^{14}CO_2$ by whole blood. This also is probably due to ^{14}C-substrate dilution. It appears that 10% sucrose is potentially the most useful osmotic agent for radiometric techniques since, although bacterial $^{14}CO_2$ production is lowered, blood $^{14}CO_2$ is lowered also. (auth)

New Tracer Techniques

Refer also to abstracts 23896, 23952, 23953, 23988, 24065, 24068, 24087, 24088, 24274, 24288, 24481, 24514, 24524, 24525, 24540, and 26507.

24549 RADIONUCLIDE IMAGING OF THE SPLEEN IN SUSPECTED SPLENIC INJURY. Nebesar, R. A.; Rabinov, K. R.; Potsaid, M. S. (Cardinal Cushing General Hospital, Brockton, MA). Radiology; 110: No. 3, 609-614(Mar 1974).

Radiocolloid images of the spleen using ^{99m}Tc-sulfur colloid, were obtained in 32 patients with suspected splenic trauma. Studies were positive in 11 of 12 patients who ultimately proved to have splenic injury and negative in 16 patients, one of whom proved to have splenic injury. Three studies were interpreted as equivocal, and no injury was confirmed. The results of the radionuclide procedure compared favorably with those of selective angiography. Thus, although an abnormal radionuclide image is not specific for splenic injury, it is recommended as the primary method of evaluation for possible splenic trauma, with angiography reserved for unusual or equivocal cases. (auth)

24550 ^{67}Ga AS A DIAGNOSTIC AGENT FOR THE DETECTION OF HEAD AND NECK TUMORS AND LYMPHOMA. Silberstein, E. B.; Kornblut, A.; Shumrick, D. A.; Saenger, E. L. (Univ. of Cincinnati). Radiology; 110: No. 3, 605-608(Mar 1974).

The ability of ^{67}Ga scanning to detect clinically suspected head and neck tumors and lymphoma was evaluated. The radionuclide findings correlated with the pathological findings 65% of the time in squamous-cell carcinoma of the head and neck and were 87% accurate in lymphoma. Although the sensitivity of ^{67}Ga testing was less in squamous-cell carcinoma of the head and neck than in lymphoma, specificity was comparable. Areas of normal ^{67}Ga uptake in the salivary glands and upper mediastinum may obscure neoplasms in these areas. The ^{67}Ga scans added nothing to the staging of carcinoma of the head and neck but were of value in detecting intraabdominal lymphoma in patients in whom lymphangiography was contraindicated. (CH)

24551 CLINICAL CORRELATIONS OF ^{67}Ga AND SKELETAL WHOLE-BODY RADIONUCLIDE STUDIES WITH RADIOGRAPHY IN EWING'S SARCOMA. Frankel, R. S.; Jones, A. E.; Cohen, J. A.; Johnson, K. W.; Johnston, G. S.; Pomeroy, T. C. (National Cancer Inst., Bethesda, MD). Radiology; 110: No. 3, 597-603 (Mar 1974).

Twenty-seven patients with Ewing's sarcoma were evaluated by whole-body radionuclide studies, using ^{67}Ga citrate and ^{18}F or ^{99m}Tc polyphosphate. Correlative diagnostic radiography was performed on all patients. Whole-body scanning, bone scanning, and radiography were of equal usefulness in diagnosing the primary lesion. Skeletal metastases were evaluated most effectively with bone scanning, 12 of 13 cases being thus detected, whereas 8 of 13 were detected on gallium images and 4 of 13 on radiographs. Lung metastases were found in 7 of 8 cases with radiography but in only 1 of 8 gallium scans. (auth)

24552 METHODS IN THE QUANTITATION OF ANTIGEN–ANTIBODY REACTIONS MEASURED BY RADIOIMMUNOASSAY: APPLICATION TO THE GASTRIN SYSTEM REVEALING LARGE AND RESTRICTED BINDING ENERGIES. Goldenberg, K.; Berkowitz, J. M.; Praissman, M. (Nassau County Medical Center, East Meadow, NY). J. Immunol.; 112: No. 3, 1008-1018 (Mar 1974).

Quantitative methods are presented for defining antigen–antibody interactions in the radioimmunologic assay system when only the bound to free ratio of labeled antigen and the concentration of unlabeled antigen are known. From these methods the equilibrium constant (K), the antibody site concentration (Ab_T), the number of binding sites (n), and the extent of binding energy heterogeneity (α) are derived for the gastrin-antiporcine gastrin antibody interaction by using human synthetic gastrin for both the labeled and unlabeled antigen. In one method, models of various orders of interaction are applied to the data and suggest a univalent homogeneous gastrin-antibody reaction. In two other methods a form of the Scatchard equation and Sips distribution are applied to the experimental data to obtain an n of one and an α close to one, respectively. Values for K are found by all three methods. The interaction was studied at six different antibody dilutions and the equilibrium constant and effective antibody site concentration at the largest dilution were 2.71×10^{11} M^{-1} and 1.09×10^{-12} M, respectively. (auth)

24553 DETERMINATION OF SERUM T_3 (TRIIODOTHYRONINE) BY RADIOIMMUNOASSAY METHOD. Hachiya, T.; Ochi, Y.; Yoshimura, M.; Shiomi, K.; Miyazaki, T. (Kyoto Prefectural Univ. of Medicine). Kaku Igaku; 10: No. 5, 457-465(Oct 1973). (In Japanese).

For the determination of serum T_3 level, radioimmunoassay using the double antibody method was developed. A specific antibody to T_3 was made in rabbit immunization with T_3 conjugated to bovine serum albumin with carbodiimide. The antibody had a cross reactivity of <0.001, <0.001, and 0.17% with L-monoiodotyrosine, L-diiodotyrosine, or L-thyroxine respectively. The incubation was performed with test serum (0.1 ml, 8-anilino-1-naphthalene sulfonic acid (300 γ)), ^{125}I-T_3 (16 pg) and rabbit antiserum specific to T_3 in pH 7.8, 0.15 M phosphate buffer for 2 days and then the second antibody was added. By this method T_3 could be detected from 16 to 900 pg. Normal range in euthyroid subjects was 108 ± 39 ng/dl. In hypothyroids it was usually 70 ng/dl and in some cases it was undetectable. In hyperthyroids it was over 200 up to 900 ng/dl. In euthyroid subjects T_4/T_3 ratio was about 121.4 ± 59.8 and in hyperthyroids it was 66.8 ± 26.3. However it was not calculated in hypothyroids, because T_3 was undetectable in many cases. When the hyperthyroidism patients became gradually euthyroid by the treatment with radioisotope-^{131}I, increased T_3 resin sponge uptake, serum T_4 and serum T_3 became normal range gradually respectively. Also T_4/T_3 ratio became normal range. However, when hyperthyroid symptom did not subside, T_3 and T_4/T_3 ratio showed still low value. The similar results were obtained when the hyperthyroid patient was treated by anti-thyroid drug. Therefore, the determination of T_3 and T_4/T_3 ratio is valuable to speculate the prognosis of hyperthyroid patients by various treatments. Serum T_2 values were determined by Dainabot Kit using dextran-coated charcoal for the separation of free and bound, and compared with the value by our double antibody method. The determined values by these two methods showed good correlation ($r = 0.86$). (auth)

24554 DOUBLE PULSE LABELLING WITH ^3H-THYMIDINE. A Method for Calculating Cell Population Kinetics. Sharav, Y.; Brin-Erb, I.; Sciaky, I. (Hebrew Univ., Jerusalem). Cell Tissue Kinet.; 6: No. 6, 527-534(Nov 1973).

A method was developed for calculating cell population kinetics with the aid of double pulse labeling with ^3H-thymidine (^3H-TdR). The labeling index was measured from autoradiographs of the oral epithelium of two groups of 30-day-old rats. One group was injected once with ^3H-TdR the other twice, with a time interval of 90 min between injections. DNA synthesis time was calculated from the equation: $T_s = [LI_1/(LI_2 - LI_1)]\ XT_1$ where T_s = synthesis time; LI_1 = labeling index in the single-injected group; LI_2 = labeling index in the double-injected group; and T_i = time interval between injections. Synthesis time in the palate was 4.8 hr and 7.6 hr in the tongue. Generation time was calculated from the equation: $T_G = (T_s/LI_1) \times 100$, where T_G = generation time. Generation time in the palate was 46.1 hr and 15.8 hr in the tongue. (auth)

24555 RADIOIMMUNOASSAY OF DIGOXIN. Sasaki, Y.; Kaibara, N. (Tokyo Univ.). Rinsho Kagaku; 19: No. 9, 1158-1162 (Sep 1973). (In Japanese).

An artificial antigen combined with bovine serum albumin (BSA) and digoxin was used, because digoxin has a low molecular weight and no antibody producing capacity. An artificial antigen was administered to a rabbit, and after 30 to 70 days an antiserum of high antibody value was obtained. This serum was strongly specific to digoxin, especially to the aglycon fraction. ^3H-digoxin was used as labeled-antigen, and the dextran-coated charcoal method was used. The relationship between a dose of digoxin (maintenance dose) and the concentration of digoxin in the blood was studied in 113 cases. There was a correlation between the maintenance dose of digoxin and the level in the blood. In cases with renal insufficiency with the same maintenance dose of digoxin, the concentration in the blood became far higher. In the methods for digitalis measurement in the blood such as bioassay, Rb, the double isotope dilution derivative assay, radioimmunoassay with ^{125}I-digitoxin, and enzymatic assay, the principle, the sensitivity, and other problems were compared. RIA in the measurement of digoxin was a superior method for clinical investigation, in which low concentrations of digoxin in the blood could be more simply measured in a short time. (JA)

24556 STUDIES ON INSULIN IMMUNOASSAY. Tarumi, Y. (Osaka Medical School, Takatsuki, Japan). Minami Osaka Byoin Igaku Zasshi; 20: No. 2-3, 164-179(Nov 1972). (In Japanese).

Radioimmunoassay of insulin in the serum was done using the double antibody method, and the data was processed by computer in order to improve the accuracy and to shorten the time required for processing. Iodine-125-labeled insulin with specific radioactivity of 90 mCi/mg was considered to be suitable for general routine examination because it provided enough sensitivity and its physical half life was longer compared to ^{131}I labeled insulin. The first antibody of excessive concentration resulted in the lowering of sensitivity while the considerably high concentration of the second antibody did not affect the practical use. When reagents were divided, using a hole pipette of 0.5 ml with most careful attention is the best way to ensure the precision of the determination. Standard curves were expressed by polynomials, and the program for processing was made using assembler. It was clarified that when cubics were used as approximate expression, reduction of error was slight within the range of 0 to 10 mμg/ml of insulin while remarkable reduction of error was seen within the range of 0 to 20 mμg/ml. Comparison of the measurement results obtained by conventional method of gross observation and estimated by mini-computer revealed the reduced standard deviation from 0.34 mμg/ml to 0.28 mμg/ml by utilizing mini-computer. (JA)

24557 USE OF HUMAN γ RAY SPECTROMETRY FOR DETERMINING THE TOTAL POTASSIUM VARIATIONS IN PATIENTS WITH CARDIAC TROUBLES. Preliminary Results for 200 Patients. Pernod, J.; Raad, A.; Kermarec, J.; Poutrain, P.; Prat, G.; Frossard, H. (Hopital d'Instruction des Armees Percy, Clamart, France). Ann. Med. Interne; 124: No. 8, 625-630 (Aug 1973). (In French).

stituted by ^{40}K, an isotope emitting 1460 keV gamma radiation. The total potassium of the organism can thus be evaluated from measurements made on individuals in an enclosure. Solid scintillator techniques are used for these measurements. Two hundred individuals were examined using this technique. A significant difference was observed between the potassium levels of individuals presenting and not presenting diuresis, and in the case of the former, those having received less than six months treatment. The sensitivity of the method is such that a drop in the total potassium level resulting from diuretic treatments of only a few days could be established. (FR)

24558 STUDIES ON DIAGNOSTIC USEFULNESS OF VENTILATION/PERFUSION SCINTIPHOTOGRAPHY USING XENON ISOTOPE FOR CARDIOVASCULAR AND PULMONARY DISEASES. Sakakibara, H.; Sugita, M.; Yamada, K.; Yoneda, S.; Matsubara, T. (Osaka Univ.). Radioisotopes (Tokyo); 22: No. 8, 433-439(Aug 1973). (In Japanese).

Diagnostic methods like selective pulmonary angiography, bronchography, or bronchospirometry for cardiovascular and pulmonary diseases, which can evaluate regional function of the lungs, were established. However, these procedures have the disadvantage of complexity and demand the cooperation of the patient. Recently technical advances such as introduction of new radionuclide preparations, improved imaging devices and computer system concerned with data-procedures, have further enhanced the clinical utility of nuclear medicine. An important problem in the use of xenon isotope in a given patient with cardiovascular or pulmonary disease is detecting regional pathophysiologic conditions of the lungs without any troubles. Defects or characteristic irregularities in xenon distribution during inhalation or perfusion studies can be obtained in some patients with disorders of airway tracts or blood vessels such as pulmonary thromboembolism, bronchial carcinoma, and pulmonary sequestration etc. (auth)

24559 INTRAVASCULAR SURVIVAL OF NEUTROPHILS LABELED IN VIVO. Vincent, P. C.; Chanana, A. D.; Cronkite, E. P.; Joel, D. D. (Brookhaven National Lab., Upton, NY). Blood; 43: No. 3, 371-377(Mar 1974).

The survival of blood neutrophils labeled in vivo with tritiated thymidine was studied in the calf. Disappearance of labeled neutrophils from the blood of calves was followed after a period of cross circulation with their chimeric, immunologically tolerant twins, which had been given tritiated thymidine 6.5 days previously. Under these conditions, neutrophils were shown to leave the blood in a random exponential fashion, with half-disappearance times of between 6.4 and 7.5 hr. Hydrocortisone given to one calf 48 hr after cross circulation caused a neutrophilic leukocytosis, during which substantial numbers of labeled neutrophils reappeared in the blood. (auth)

24560 EFFECT OF EXPERIMENTAL HYPER- AND HYPOTHYROIDISM ON RADIOINSULIN METABOLISM IN RAT LIVER. Costiner, E.; Simionescu, L.; Oprescu, M. Stud. Cercet. Endocrinol.; 23: No. 4, 253-258(1972).

Twenty-five experiments were performed, by the perfused liver technique, on white male rats of both sexes, weighing 200 to 250 g each, and divided into three groups: the liver collected from animals for 12 days, 5 g triiodothyronine 150 g body weight from thyroidectomized male and female rats; perfusions with a mixture of a normal rat blood, heparinized Ringer–Locke physiological solution (equal parts) and addition of ^{125}I-insulin and non-labelled insulin. The findings revealed that hyperthyroidism enhances the hepatic capacity of insulin degradation while hyperthyroidism slows down this effect. It was assumed that the circulating level of thyroid hormones influences glutathione-insulin-transhydrogenase activity, a fact that would account for one of the factors interfering with the complex mechanism of hyperthyroidism associated diabetes and hypoglycaemia associated myxedema. (Rom. Sci. Abstr.)

24561 ISOTOPIC AND NONISOTOPIC ESTIMATIONS OF FERTILIZER NITROGEN UPTAKE BY SUDANGRASS IN FIELD EXPERIMENTS. Westerman, R. L.; Kurtz, L. T. (Univ. of Illinois, Urbana). Soil Sci. Soc. Amer., Proc.; 38: No. 1, 107-109(1974).

Recoveries of fertilizer N in above-ground portions of crops grown in field experiments were estimated by: the difference method; linear regression of total N in crops on rates of applied N; ^{15}N isotopic tracer method; and linear regression of labeled fertilizer N uptake on rates of labeled fertilizer N. In order to evaluate the use of the isotope, these four methods were applied to data from previously reported experiments that involved two ^{15}N-labeled fertilizers (urea and oxamide) at rates of 0, 56, 112, and 168 kg N/ha. The test crop was Sudax (SX11) sorghum-sudangrass hybrid (Sorghum sudanense) and harvests were made at approximately 30-day intervals during the cropping seasons. The difference method overestimated recovery of urea and oxamide nitrogen in sudangrass 35 and 31%, respectively, in 1966 and 23 and 35% in 1967 when compared to the isotopic tracer method. Similarly, linear regression of total N in crops on rates of N overestimated recoveries of urea and oxamide nitrogen 32 and 17%, respectively, in 1966 and 17 and 21% in 1967 when compared to linear regressions of fertilizer N in crops on rates of ^{15}N labeled nitrogen. Isotopically-labeled fertilizers are almost a necessity for estimating N recovery in many agronomic experiments. (auth)

24562 SUBCUTANEOUS EXTRAVASATION OF CSF DEMONSTRATION BY SCINTICISTERNOGRAPHY. Front, D.; Penning, L. (University Hospital, Groningen, Netherlands). J. Nucl. Med.; 15: No. 3, 200-201(Mar 1974).

The scinticisternographic findings using ^{131}I-HSA in a case of traumatic subcutaneous extravasation of CSF into the facial region are described. This extravasation has to be differentiated from local accumulation of radioactivity inside the CSF spaces. (auth)

24563 CEREBRAL VENTRICLE VISUALIZATION DURING BRAIN SCANNING WITH ^{99m}Tc-PERTECHNETATE. Fulmer, L. R.; Sfakianakis, G. N. (Ohio State Univ., Columbus). J. Nucl. Med.; 15: No. 3, 202-204(Mar 1974).

Ventricular visualization during ^{99m}Tc-pertechnetate brain scanning is probably due to increased permeability of the blood spinal fluid barrier to the technetium ion. It has been shown by others that various disease states affect the permeability of the blood spinal fluid barrier in adults and these permeability changes may be even more striking in infancy. The ventricular visualization noted in four patients was due to intraventricular infection in three (proven in two, suspected in one) and secondary to hyperthermic or anoxic damage to the CNS in one. The presence or absence of ventricular visualization seems to bear a direct relationship to the severity of the intraventricular infection (as determined by CSF analysis). (auth)

24564 RADIONUCLIDE ANGIOCARDIOGRAPHIC CONFIRMATION OF TRICUSPID INSUFFICIENCY. Mishkin, F. S.; Prosin, M. A. (Charles R. Drew Postgraduate Medical School, Los Angeles). J. Nucl. Med.; 15: No. 3, 205-206(Mar 1974).

In a patient with clinically certain tricuspid regurgitation, the ^{99m}Tc γ camera angiogram clearly demonstrated reflux of blood into the inferior vena cava from the right atrium. (auth)

24565 UPTAKE OF ^{99m}Tc-STANNOUS POLYPHOSPHATE IN AN AREA OF CEREBRAL INFARCTION. Wenzel, W. W.; Heasty, R. G. (Presbyterian Medical Center, Denver). J. Nucl. Med.; 15: No. 3, 207-209(Mar 1974).

Two cases of uptake of ^{99m}Tc-stannous polyphosphate in cerebral infarctions are presented. The possibility of this isotope being used to differentiate infarction from tumor is discussed and the superiority of ^{99m}Tc-stannous polyphosphate to outline the area of infarction is demonstrated. (auth)

24566 RADIONUCLIDE VENOGRAPHY (RNV) IN LOWER EXTREMITY VENOUS DISEASE. Henkin, R. E.; Yao, J. S. T.; Quinn, J. L. III; Bergan, J. J. (Northwestern Univ., Chicago). J. Nucl. Med.; 15: No. 3, 171-175(Mar 1974).

Radionuclide venography (RNV) of the pelvis and lower extremity veins using ^{99m}Tc-albumin microspheres was performed in 53 patients with pulmonary emboli or venous disease. In 25 patients who underwent both contrast radiography and RNV studies, there were no false-positive studies and one false-negative. In this series the accuracy of RNV exceeded that of Doppler alone. When the results of these two methods were combined, false-negative studies were eliminated. Over half the patients with pulmonary emboli and clinically normal lower extremities had abnormal RNV studies. The exact method of thrombus localization is not known but both mechanical and electrostatic factors may be involved. RNV has been shown to be a safe, accurate, and easily performed examination that is particularly useful in evaluating patients with pulmonary emboli. (auth)

24567 ASSESSMENT OF CIRCULATION IN THE FEMORAL HEAD BY ^{18}F SCINTIGRAPHY. Riggins, R. S.; DeNardo, G. L.; D'Ambrosia, R.; Goldman, M. (Univ. of California, Davis). J. Nucl. Med.; 15: No. 3, 183-186(Mar 1974).

Use of ^{18}F and a scintillation positron camera permitted the detection of radioactivity in the femoral head of dogs. Absence of ^{18}F correlated with avascularity and the presence of ^{18}F with vascularity of the femoral head. The findings were documented by histological and tetracycline labeling techniques. Revascularization of the femoral head was detected as early as one month after surgically induced avascularity. Preliminary studies in patients support these observations. The results of this investigation suggest that this radioisotopic technique may prove to be a practical method of assessing femoral head circulation and predicting avascular necrosis of the femoral head. Early diagnosis of avascularity of the femoral head following femoral head fracture could significantly reduce the morbidity of this disease. (auth)

24568 ^{99m}Tc-TETRACYCLINES: PREPARATION AND BIOLOGICAL EVALUATION. Dewanjee, M. K.; Fliegel, C.; Treves, S.; Davis, M. A. (Harvard Medical School, Boston). J. Nucl. Med.; 15: No. 3, 176-182(Mar 1974).

The broad-spectrum antibiotic, tetracycline, and three if its analogs have been successfully labeled with ^{99m}Tc. Organ distribution studies indicated potential clinical utility for these compounds as kidney and gallbladder imaging agents. Of the four radiopharmaceuticals studied, ^{99m}Tc-tetracycline had superior pharmacodynamics and was selected for further study. Stability studies showed the complex to be rather labile but if kept at 4°C in the absence of light and oxygen, its stability was satisfactory for use in diagnostic nuclear medicine. Investigations carried out with double-labeled tetracycline (^{99m}Tc and ^{113m}Sn) and ^{113m}Sn-tetracycline shed light on the role of stannous ion and its effect upon biodistribution. Acute and sub-acute toxicity studies in dogs, mice, rats, and rabbits showed no undesirable effects and a clinical evaluation in selected patients is currently in progress. (auth)

24569 ENHANCEMENT OF UPTAKE WITH ESTRADIOL TREATMENT OF A RADIOLABELED IRREVERSIBLE COMPETITIVE ENZYME INHIBITOR IN THE ADRENAL CORTICES AND OVARIES OF RATS WITH ENDOCRINE AUTONOMOUS BREAST CARCINOMAS. Ryo, U. Y.; Beierwaltes, W. H.; Ice, R. D. (Univ. of Michigan, Ann Arbor). J. Nucl. Med.; 15: No. 3, 187-189(Mar 1974).

The uptake of ^{14}C-isoxazole in the adrenals and ovaries of tumor-bearing rats was enhanced by estrogen treatment. There was no significant effect on the uptake of the enzyme inhibitor in breast tumor. (auth)

24570 EVALUATION OF AN IMPROVED ^{99m}Tc-STANNOUS AGGREGATED ALBUMIN PREPARATION FOR LUNG IMAGING. Monroe, L. A.; Thompson, W. L.; Anderton, N. S.; Burdine, J. A. (Baylor Coll. of Medicine, Houston, TX). J. Nucl. Med.; 15: No. 3, 192-194(Mar 1974).

An improved preparation of ^{99m}Tc-labeled stannous aggregated albumin for lung imaging was evaluated. The kit consists of a vial of frozen human serum albumin aggregates labeled by a simple, rapid procedure with an efficiency consistently greater than 97%. Particle size distribution is excellent with 83% of particles having a diameter of 10 to 60 microns. No significant changes in particle size range or labeling efficiency were observed in kits refrigerated at 4°C up to 4 weeks compared with kits kept frozen. The quality of lung images was excellent and no adverse reactions were observed in a series of 50 patients with a variety of pulmonary disorders. (auth)

24571 TUMOR SCANNING WITH ^{169}Yb-CITRATE. Hisada, K.; Tonami, N.; Hiraki, T.; Ando, A. (Kanazawa Univ., Japan). J. Nucl. Med.; 15: No. 3, 210-212(Mar 1974).

The results of tumor scanning with ^{169}Yb-citrate are presented. Positive scans were obtained in 13 of 15 patients with primary lung and liver cancer or lymphosarcoma and various metastatic lesions of bone. The advantages and disadvantages of ^{169}Yb as a tumor-scanning agent are discussed. (auth)

24572 LABELING OF ANTIBODIES WITH ^{3}H-ACETATE. Kalmakoff, J.; Parkinson, A. J. (Univ. of Otago, Dunedin, New Zealand). Appl. Microbiol.; 26: No. 4, 624-626(Oct 1973).

Antibodies can be labeled with ^{3}H-iodoacetate at pH 9.8 without significant loss of biological activity, and the labeled antibody can be used to detect viral antigens. (auth)

24573 MICROTITER SOLID-PHASE RADIOIMMUNOASSAY FOR HEPATITIS B ANTIGEN. Purcell, R. H.; Wong, D. C.; Alter, H. J.; Holland, P. V. (Lab. of Infectious Diseases, Bethesda, Md). Appl. Microbiol.; 26: No. 4, 478-484(Oct 1973).

A micro-solid-phase radioimmunoassay (micro-SPRIA) for hepatitis B antigen (HB Ag) was developed for use with microtiter serological equipment. Radiolabeled immunoglobulin G was prepared from human and animal sera containing hepatitis B antibody (HB Ab); it was not necessary to isolate specific HB Ab by immunochemical means. A micro-SPRIA prepared with guinea pig reagents was approximately as sensitive as the AusRIA radioimmunoassay, but, like the AusRIA test, yielded false positive results. A micro-SPRIA prepared with human reagents was slightly less sensitive but did not yield false positive results. These micro-SPRIA tests offer several advantages, including conservation of reagents, adaptability to other antigen-antibody systems, ease of performance (especially when testing large numbers of specimens), and economy. (auth)

24574 RADIOIMMUNOASSAY FOR TYPE A TOXIN OF CLOSTRIDIUM BOTULINUM. Boroff, D. A.; Shu-Chen, G. (Albert Einstein Medical Center, Philadelphia). Appl. Microbiol.; 25: No. 4, 545-549(Apr 1973).

A preparation of pure type A toxin of Clostridium botulinum was labeled with ^{131}I in the presence of chloramine-T and carrier-free isotope. The radioactive toxin (^{131}I Tox) was used in a radioimmunoassay procedure similar to that of Berson and Yalow. Dilutions of antibody to the toxin, capable of binding 50% of the added ^{131}I Tox, were mixed with a sample of the labeled toxin and various concentrations of unlabeled toxin ('Cold' Tox). When concentration of Cold Tox were plotted against the ratio ^{131}I bound/^{131}I not bound, a standard curve was established that could be used to estimate the concentration of Cold Tox in a test mixture. This assay was sensitive to as little as 100 mouse minimum lethal dose and was highly specific for the serological type of the toxin used. (auth)

24575 COMPARISON OF DIRECT AND INDIRECT SOLID-PHASE MICRORADIOIMMUNOASSAYS FOR THE DETECTION OF VIRAL ANTIGENS AND ANTIVIRAL ANTIBODY. Rosenthal, J. D.; Hayashi, K.; Notkins, A. L. (National Inst. of Dental Research, Bethesda, MD). Appl. Microbiol.; 25: No. 4, 567-573(Apr 1973).

Viral antigens were fixed to the surface of microtiter wells, and serial dilutions of antiviral antibody were added. The amount of antiviral antibody bound to viral antigens was determined by measuring the extent to which the antiviral antibody either inhibited the specific binding of ^{125}I-labeled antiviral immunoglobulin G (IgG) (direct technique) or enhanced the specific binding of ^{125}I-labeled anti-IgG (indirect technique). Immune complexes composed of viral antigens and antiviral antibody (human) could be detected by the binding of ^{125}I-labeled rheumatoid factor. Specific binding was influenced by the concentration of protein in the diluents used during the different steps of the procedure. A high concentration of protein in the diluent used with the viral antigens decreased specific binding, whereas a high concentration of protein in the diluent used with ^{125}I-labeled anti-IgG increased specific binding by decreasing nonspecific attachment of the labeled anti-IgG. Under the conditions employed, the titer of a given antiviral serum was several hundredfold greater by the indirect than by the direct technique. (auth)

24576 USE OF TECHNETIUM (^{99m}Tc) AS A BACTERIAL LABEL IN LUNG CLEARANCE STUDIES. Johanson, W. G. Jr.; Kennedy, M. A.; Bonte, F. J. (Univ. of Texas, Dallas). Appl. Microbiol.; 25: No. 4, 592-594(Apr 1973).

The suitability of technetium (^{99m}Tc), a gamma emitter, for labeling of Diplococcus pneumoniae in studies of lung bacterial clearance was examined. A killed bacterial slurry with high specific activity was obtained with a ferric ascorbate reducing system. Approximately 5.5% of radioactive counts dissociated from labeled bacteria in 6 h. Rats were exposed to a uniformly mixed aerosol of untagged, viable pneumococci and killed, ^{99m}Tc-tagged pneumococci. The aerodynamic behavior of labeled and unlabeled pneumococci was similar. Viable bacterial counts and radioactive counts were determined in lung homogenates at intervals following exposure, and rates of bacterial killing and disappearance of radioactive counts were plotted. Radioactive counts did not increase in the liver during the period of observation, suggesting that the decrease in lung radioactivity represents mucociliary clearance and not release of isotope to the systemic circulation. The use of ^{99m}Tc for bacterial labeling provides advantages of technical simplicity and personnel safety compared to the use of beta-emitting isotopes. (auth)

24577 INCORPORATION OF RADIOACTIVE ACETATE INTO DIACETYL BY STREPTOCOCCUS DIACETILACTIS. Speckman, R. A.; Collins, E. B. (Univ. of California, Davis). Appl. Microbiol.; 26: No. 5, 744-746(Nov 1973).

Streptococcus diacetilactis was grown in a partially defined, lipoic acid-free medium containing radioactive acetate with and without addition of 0.1% unlabeled sodium pyruvate. Labeled carbon was incorporated into diacetyl, but neither the amount of diacetyl produced nor its specific activity was influenced by addition of pyruvate. Acetoin had low specific activity, indicating that it was a mixture of radioactive and nonradioactive acetoin. The specific activity of acetoin was lower when pyruvate, a precursor of unlabeled acetoin, was added to the medium, which indicated that the radioactive acetoin was produced from radioactive diacetyl by diacetyl reductase. Results substantiate condensation of acetyl-coenzyme A with hydroxyethylthiamine pyrophosphate as the in vivo mechanism for synthesis of diacetyl. (auth)

MATERIALS

24578 (COO-1629-41) THERMAL AND ELECTRICAL MEASUREMENTS ON SOLIDS AT LOW TEMPERATURES. Weinstock, H. (Illinois Inst. of Tech., Chicago (USA). Dept. of Physics). Feb 1974. Contract AT(11-1)-1629. 26p. Dep. NTIS $3.50.

The following research is reported: thermal conductivity of electron-irradiated and additively colored MgO; thermal conductivity of Pb films in the intermediate state; thermal conductivity of neutron-irradiated pyrolytic graphite; specific heat of $(CH_3)_4NMnCl_3$; and thermal conductivity of normal and superconducting Pb−Tl alloys (1 and 20% Tl). (22 references, 10 figures) (DLC)

24579 ADVANCES IN NUCLEAR TECHNOLOGY: MATERIALS SELECTION, WELDING, AND TESTING AND INSPECTION. Metal Progr.; 105: No. 3, 79-80; 83; 86; 89-94; 96; 98; 100; 103(Mar 1974).

Experience with ASTM A533-B steel and the HSST program are described; ASTM A543 is seen as the material for pressure vessel fabrication. Nuclear applications and problems of stainless steels are also discussed. Various other material selection topics are discussed: HTGR materials, core components, plastics, etc. Problems in the welding of pressure vessel steels, and stainless steels, and alloys and their solution are discussed in detail. Developments in nondestructive testing methods for in-service reactor inspections are described. (7 figures) (DLC)

24580 MATERIALS AND MAN'S NEEDS. Metal Progr.; 105: No. 3, 7-10(Mar 1974).

A survey is presented of the findings of the COSMAT (NAS's Committee on the Survey of Materials Science and Engineering) report. The importance of the field today and the scientific personnel involved are pointed out. Challenges are identified, and a plan of action is spelled out. (DLC)

Ceramics and Cermets

Refer also to abstracts 23990, 24024, 24025, 24033, 24640, 24641, 24671, 24736, 24783, 24812, 25950, 26011, 26029, 26045, 26048, 26050, 26087, 26095, 26138, 26169, 26271, 26505, and 26518.

24581 (AAEC/TM-579) PRODUCTION OF SINTERABLE URANIUM DIOXIDE FROM AMMONIUM DIURANATE IN A PULSED FLUIDISED BED REACTOR: INTERIM REPORT. Fane, A. G.; Alfredson, P. G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Dec 1970. 30p. Dep. NTIS (U.S. Sales Only) $3.50.

Results and operational experience are reported for the batchwise production of uranium dioxide from ammonium diuranate in a pulsed fluidized bed reactor. Alternative proposals for batch/continuous operation are assessed and compared with continuous operation. The future development program is outlined. (auth)

24582 (AAEC/TM-583) PRELIMINARY DESIGN AND COST CONSIDERATIONS FOR A PLANT TO PRODUCE NUCLEAR PURITY URANIUM DIOXIDE FROM AUSTRALIAN ORE CONCENTRATES. Charlton, B. G.; Alfredson, P. G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Mar 1971. 40p. Dep. NTIS (U.S. Sales Only) $4.00.

Design considerations are outlined for plants for the production of nuclear purity uranium dioxide with capacities of 100, 200 and 500 tonnes U/year. The cost of the process equipment is not greatly affected by various process alternatives; equipment performance, which affects product quality, consistency of powder properties and plant reliability, is important in determining the recommended process. This involves the following steps: batch dissolution, continuous solvent extraction in mixer-settlers, single-stage precipitation of ADU, thickening and spray drying of ADU, and calcination-reduction in continuous pulsed fluidised bed reactors. Estimates of the cost of recovery of free acid and combined nitrate from the raffinate and filtrate waste streams indicated that the value of the recovered acid would be greater than the processing cost only in the case of free acid recovery from solvent extraction raffinate in the 500 tonne/year plant. However if acid recovery is necessary for plant effluent control, the processing cost can be largely offset by the value of the recovered acid. (auth)

24583 (AD-765646-5) SYNTHESIS OF RARE EARTH COMPOUNDS AND STUDY OF THEIR MAGNETIC, OPTICAL, AND SEMICONDUCTING PROPERTIES. Final Technical Report, 30 June 1972−30 June 1973. Holtzberg, F.; Shafer, M. W.; Tao, L. J.; von Molnar, S.; Torrance, J. B. (IBM Watson Research Center, Yorktown Heights, N.Y. (USA)). Jul 1973. Contract DAAH01-71-C-1313. 24p. NTIS $2.75.

Activities in a three year effort in the study of the synthesis of rare earth compounds and an investigation of their magnetic, optical, and semiconducting properties are summarized. The development of the growth of single crystals from the simple face centered cubic magnetic insulating rare earth chalcogenides, to the more complex Th3P4 type structures and lower symmetry layer compounds, is described. Objectives include the synthesis of higher purity materials, the improvement of crystal perfection, and measurement of deviations from stoichiometry. Techniques for growing single crystals of varying compositions of solid solutions between di and trivalent rare earth chalcogenides and methods used for their characterization are developed. The reasoning which led to the variety of experiments referred to in the report is discussed with emphasis on the relationship between magnetic and electronic properties of these systems. The direct relationship of magnetism to the band structure is discussed, as reflected in transport, tunneling and optical measurements. (GRA)

24584 (AEC-tr-7529) STOICHIOMETRY OF THE OXIDE $U_3O_{8\pm x}$: INFLUENCE OF TEMPERATURE AND PRESSURE. Rodriguez de Sartre, M. S.; Phillipot, J.; Moreau, C. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). May 1967. Translation of CEA-R-3218. 11p. Dep. NTIS $3.00.

The composition of uranium oxides in equilibrium with oxygen was studied at oxygen pressures of 20, 50, 100, 200, 400, and 600 mm of mercury, and temperatures of 400, 600, 800, and 1000°C. (auth)

24585 (BARC-693, pp 129A-192) SOLID STATE STUDIES SECTION. 1973.

Research is summarized on fuel, fertile, and cladding materials. Results of studies in the field of solid state sciences are also reported. It was found during the studies on the thermal diffusion release of ^{133}Xe from irradiated thoria−urania powders that during prolonged annealing at high temperatures, there were several sudden burst releases of ^{133}Xe as a function of time. These sudden bursts appear to be related to the particle size of the powders. Studies on the phase composition of U_3O_8 established that the phase obtained at room temperature after heating at 850°K is always oxygen deficient. Results of studies on the different modifications of U_3O_8 indicated that the so-called delta-phase has a crystal structure almost identical with the beta-phase, yet there were differences in the heats of transition of each of these phases to the alpha-U_3O_8 phase at 130°C. Studies on fast neutron damage in stainless steel were initiated and results related to damage by void formation were obtained even when the fluencies were only moderately high. Studies on the phase transformations in solids brought out the unusual phase transition behavior of KNO_3. It was established that the phase transformation attributed to the orthorhombic (II) to the trigonal (I) transition at 129°C is essentially a 2-step transition. Results of differential scanning colorimeter (DSC) studies also revealed a peculiar feature which is as yet not understood, namely that on cooling, differential thermal analysis (DTA) showed a III to II phase transition; this is not seen in the DSC. The capabilities of the DSC technique to delineate temperatures of magnetic transitions were demonstrated by studying the transitions in a number of standard substances (metals, alloys, and compounds). In studies on $KMnF_3$, it was further demonstrated that the DSC technique is superior in measuring and detecting the heats of crystallographic and magnetic transitions. Heats of transition as small as 2 cal/mole were detected. Studies on the thermodynamics of high temperature materials showed the effects of water vapor on the volatility of U_3O_8 phase. Similar studies were completed on germanium oxide and Group IV oxides. Phase transformation in lanthanum cobaltate was delineated by solid galvanic cell techniques and the free energy formation was calculated. Electrical properties of polycrystalline NiTe thin films showed that the electrical resistivity, temperature coefficient of resistance, and the Hall coefficient were functions of the film thickness. Work has been initiated to use these thin films for developing gauss-meters. In the field of instrumentation, efforts were directed on the microthermogravimetric system incorporating the Sartorius Model 4102 thermobalance. The system, as developed, is capable of continuous operation at 1 microgram sensitivity in static air or vacuum up to 1000°C or at 5 microgram sensitivity in flowing gases. In theoretical work the s−d mixing model was used to derive spin wave dispersion relation and obtain the shape of the optical absorption spectrum in transition metals. Spin wave dispersion relations were derived for $Mn_xCo_{1-x}F_2$ and gave qualitative agreement with experiment. The Hartree–Fock and Unrestricted Hartree–Fock calculations on H_2 were extended to include configuration interaction. The semilocalized orbital method was extended to HeH^+. (auth)

24586 (BNWL-tr-109) ANALYSIS OF VOID VOLUME DISTRIBUTION IN OXIDE FUEL PINS WITH HIGH PIN POWER. Hoffman, H. (Kernforschungszentrum Karlsruhe (F.R. Germany)). 10 Aug 1973. Translation of KFK-1863. 121p. Dep. NTIS $8.25.

A study was conducted to obtain quantitative knowledge of void volume redistribution by measuring radial void volume profiles of irradiated fuel pins, and by comparing these profiles with calculated ones. Short-term (He loop test group 2) and long-term irradiated pins (bundle irradiation Mol-7A) were analyzed. The irradiated fuel pins were separated using diamond-coated cutting wheels embedded in araldite and ground with emery paper of SiC. Vibrational polishing with Al_2O_3 + CrO_3 as abrasives was selected as the optimum method of sample preparation. The crack volume was taken with a ruler from cross-sectional micrographs (~70 x). The porosity distributions were provided by composite micrographs (200 x) of uncracked radial fuel regions with an image analyzing computer. The quantitative interpretation was done by comparison calculations with the fuel pin modeling computer code SATURN 1a. One of the code's features is the ability of calculating both porosity and crack volume distribution as a function of time and variable irradiation conditions. The former was calculated by means of a balance of porosity migrating in and out of a ring element, which was computed on the basis of a multifractured fuel model. It was assumed that a multifractured fuel is formed if thermal stresses are of a tensile nature and exceed the fracture stress of the fuel. A critical literature survey confirmed that the evaporation-condensation mechanism is the main contribution to total migrating velocity of pores exceeding 10 μm. Only this contribution was taken into account in the computer code and set independent of the pore radius. An additional porosity increase in the hot fuel region ($T > 1,700°C$) due to fission gas swelling was computed for long-term irradiations. Comparisons between predicted and measured radial porosity distributions show that the measured radial porosity distributions of the short-term irradiated fuel pins could be matched with the calculated ones by using appropriate heat transfer coefficients. The measured crack volume distributions were verified by predicted profiles. In short-term irradiations, the agreement was independent of the choice of a heat transfer coefficient. The discrepancies between calculated and measured porosity distributions for high burn-ups were explained by axial material transports, production of fission gas bubbles, and a negative swelling rate simulating hot pressing of the outer fuel region. (82 references) (auth)

24587 (CEA-N-1668) MASS SPECTROMETER FOR ANALYZING THE VAPOR ABOVE NUCLEAR FUELS AT HIGH TEMPERATURES. Technical Description. Poitreau, J.; Marcon, J. P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 13 Sep 1973. 11p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

Equipment was constructed for measuring the evaporation of fuel heated to high temperatures using a mass spectrometer. The following parts of the equipment are described: the ultrahigh vacuum pumping assembly (ion pump, turbomolecular pump); the mass spectrometer (comprising a quadrupole head together with its power supply); and the electron bombardment furnace. Preliminary results on the sensitivity and resolving power of the equipment are presented. (FR)

24588 (CONF-7206100-1) STUDIES OF THE ELECTRICAL PROPERTIES OF MIXED OXIDES AT HIGH TEMPERATURES. Berggren, G. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

From 3rd Nordic high temperature symposium; Riso, Denmark (7 Jun 1972).

The electronic transport mechanisms of metal oxides are not well understood. The determination of concentrations and mobilities of conduction electrons, cations, and anions as a function of stoichiometry and temperature involves numerous complexities. Practical realization of the methods of measuring electrical resistivity makes compromise necessary. Two-terminal measurements are discussed. Test conditions, e.g. contact resistance and surface conduction represent certain limiting factors for the two-terminal method. A sample holder for measuring the electrical resistivity and thermoelectric power in the temperature range of 20 to 1500°C is described. Electrical resistivity measurements have been made for UO_{2+x}, PuO_2 and UO_2-PuO_2 sintered pellets. Thermoelectric power has been measured for UO_{2+x} and UO_2-CeO_2. The results from resistivity measurements are given as a curve of the function $\ln R = f\ (1/T)$, and the activation energy is calculated for various temperature intervals. The results show evidence of a relation between resistivity and composition. Resistivity is also affected by the thermal history of the specimen. Comparison of the results with existing theories may give an explanation in terms of the small polaron theory for hopping mechanism for pure uranium dioxide. For practical purposes, the evaluation of the activation energies can be used for the determination of oxygen content. Measurement of resistivity might give valuable information about homogeneity and porosity as well as self-diffusion. (auth)

24589 (CONF-740301-3) SODIUM COMPATIBILITY STUDIES OF LOW FRICTION CARBIDE COATINGS FOR REACTOR APPLICATION. Whitlow, G. A.; Miller, R. L.; Schrock, S. L.; Wu, P. C. S. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Sep 1973. Contract AT(11-1)-3045. 19p. Dep. NTIS $3.00.

From NACE meeting–corrosion/74; Chicago, Illinois, USA (4 Mar 1974).

Design requirements for low friction materials in FFTF have led to an experimental sodium compatibility program, the objective of which is to select and qualify a low friction coating for the fuel assembly duct load pad. Results are given for chromium carbide and titanium carbide-based coatings on stainless steel exposed to 1160°F sodium for several thousand hours. A chromium carbide coating (with a nichrome binder) having an average corrosion rate of approximately 0.25 mpy exhibits optimum sodium compatibility behavior of the materials examined. Both plasma-sprayed chromium carbide and titanium carbide based coatings were found to be unstable when exposed to sodium. (auth)

24590 (EUR-5034) EXPERIMENTAL OBSERVATIONS ON UO_2 KERNAL/PyC COATING INTERACTION. Drago, A. Commission of the European Communities, Luxembourg; Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center). Jan 1974. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

The heat treatment-induced movement of UO_2 kernels through the pyrocarbon coatings of unirradiated coated particles was observed by a contact-microradiographic technique. A difference in the development of the phenomenon was observed in particles with visibly damaged coatings. (auth)

24591 (FCD/TN-22) PROCESSES FOR UO_2 PRODUCTION. Hubery, R. W.; Baillie, M. G. (Australian Atomic Energy Commission Research Establishment, Lucas Heights. Materials Div.). Aug 1966. 26p. Dep. NTIS (U.S. Sales Only) $3.50.

A review is presented of methods used for the production of uranium concentrates in Australia, and available processes for their purification and conversion to reactor grade uranium dioxide. (auth)

24592 (GEMP-6-B) HIGH TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT NO. 6, PART B. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 15 Dec 1961. Contract AT(40-1)-2847. 49p. Dep. NTIS $4.50.

Declassified 21 Sep 1973.

Research progress is reported on ceramic fuel element evaluation, coatings for fuel elements, coated fuel particles, $UO_2-Y_2O_3$ fuel materials, stabilization of fuels using Y compounds, and fission product migration in solids. (JRD)

24593 (GEMP-24-B) HIGH-TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT NO. 24, PART B. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 28 Jun 1963. Contract AT(40-1)-2847. 52p. Dep. NTIS $4.75.

Declassified 21 Sep 1973.

Research progress is reported on coatings for ceramic fuel elements, coated fuel particles, $UO_{2.9}-3Y_2O_3$ fuel materials, stabilization of UO_2 in ceramic fuel elements, and fission product migration in solids. (JRD)

24594 (GEMP-60) HIGH-TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT NO. 60. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 15 Aug 1966. Contract AT(40-1)-2847. 107p. Dep. NTIS $7.50.

Declassified 21 Sep 1973.

Research progress is reported on high temperature substoichiometric UO_2 and UO_2 solid solutions, refractory ceramic fuel elements, refractory metal–UO_2 cermets, carbide fuels and structural materials, moderators, control elements, shielding materials, burnup of Y_2O_3-stabilized UO_2, and burnup of BeO-stabilized fuel materials. (JRD)

24595 (HEDL-TME-73-5(Vol.1), pp 1.1-6) APPLIED RESEARCH. Sheely, W. F. Oct 1973.

Research and development progress is summarized on ceramic fuels properties and behavior, fast neutron absorber materials, and control element technology, and material inventory control. (JRD)

24596 (HEDL-TME-73-5(Vol.1), pp 3.1-4) COMPONENT FABRICATION. Burgess, C. A. Oct 1973.

Research and development activities are summarized on FTR fuel pin fabrication, Mark-IIC loop fabrication and testing, fabrication of FFTF fuel pins, fabrication of capsules containing tagging gases, RDT standards preparation, wire wrapping of driver fuel pins, control rod procurement, and fuel duct characterization. (JRD)

24597 (HEDL-TME-73-5(Vol.1), pp 4.1-8) FUELS. Roake, W. E. Oct 1973.

Research and development activities are summarized on radioactive materials processing, fast flux mixed oxide irradiations, and lifetime predictions for mixed oxide driver fuels. (JRD)

24598 (HEDL-TME-73-6(Vol.1)) HEDL QUARTERLY TECHNICAL REPORT, OCTOBER, NOVEMBER, DECEMBER 1973. Volume I. Materials Technology. Evans, E. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jan 1974. Contract AT(45-1)-2170. 324p. AT.

Results of applied research are presented on ceramic fuels, fast neutron absorber materials, and control elements. Materials research is reported on irradiation damage to reactor metals, alloy performance, and sodium technology. Results of research are also included on radioactive materials processing and fuel component testing. (JRD)

24599 (PWAC-436) DEVELOPMENT OF UO$_2$-BeO FUELS. Freed, M. S.; DeCrescente, M. A.; Kuhns, R. M. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 14 Jul 1965. Contract AT(30-1)-2789. 63p. Dep. NTIS $5.25.

Declassified 5 Sep 1973.

The development status of UO$_2$-BeO fuel clad with Nb-1 Zr alloy at the termination of the Lithium Cooled Reactor Experiment (LCRE) contract is described. This work, which was undertaken in early 1958 and extended through June 1963, was in support of high temperature, high power, liquid metal cooled, compact reactors. Physical properties are tabulated and fuel-cladding compatibility studies are briefly discussed. An extensive irradiation test program performed on 30 to 60 vol % UO$_2$-BeO is described in detail. Results of 66 static, liquid metal cooled capsules and two in-pile forced convection loops containing a total of 259 specimens irradiated at average cladding temperatures above 1300°F are presented and evaluated. On the basis of a maximum allowable fission gas release of 10% and the fuel swelling associated with this release, it is concluded that UO$_2$-BeO clad with Nb-1 Zr alloy is a satisfactory fuel up to approximately 4.5 atomic % U burnup when operated at cladding temperatures below 1825°F. The burnup of this fuel is limited to 2.0 atomic % U for cladding temperatures between 1850 and 1975°F and to 1.25 atomic % U for cladding temperatures above 2000°F. (auth)

24600 (SGAE-2195) X-RAY STUDY OF PYROLYTIC SILICON CARBIDE. Holub, F. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Metallurgie). Nov 1973. 11p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

An x-ray study was made on material properties of pyrolytic silicon carbide deposited on nuclear fuel particles by the pyrolysis of methyltrichlorosilane. Characteristics such as content of free silicon, estimated α/β-SiC-type ratio, lattice parameter, lattice strain, crystallite size, and preferred orientation are related to the deposition conditions. (auth)

24601 (WAPD-TM-1059) RE-SOLUTION EFFECTS AND FISSION GAS SWELLING IN UO$_2$ (LWBR DEVELOPMENT PROGRAM). Dollins, C. C.; Ocken, H. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Jun 1973. Contract AT(11-1)-Gen-14. 41p. Dep. NTIS $4.25.

A fission gas swelling model is proposed which can be used to calculate swelling in the vicinity of grain boundary networks as well as in imperfection-free regions. The grain boundary swelling requires a knowledge of the gas accumulation and the reaction-rate at the boundary. The gas accumulation was calculated by deriving a modified form of Fick's second law wherein it was assumed that because of re-solution effects the in-pile diffusion coefficient can be described as a function of the gas concentration but is independent of the actual operating time. Reaction-rates for bubbles at grain boundaries were derived in the manner discussed by de Jong and Koehler in their treatment of vacancy clustering. The results indicate that there is a grain size of $\sim 10^{-4}$ cm for which the swelling is a maximum, which maximum increases somewhat with irradiation temperature and with depletion at a constant temperature. The results can be used in prediction of the swelling and mean radius of both intergranular and intragranular fission gas bubbles at each stage of an irradiation experiment; such results can then be used to predict the re-solution parameter. Mean bubble radii predicted using the re-solution swelling model are in reasonable agreement with reported radii obtained from electron micrographs of irradiated fuel elements. (auth)

24602 (Y-1913) SURVEY STUDY OF LOW-EXPANDING HIGH-MELTING, MIXED OXIDES. Holcombe, C. E.; Morrow, M. K.; Smith, D. D.; Carpenter, D. A. (Oak Ridge Y-12 Plant, Tenn. (USA)). 14 Feb 1974. Contract W-7405-eng-26. 24p. Dep. NTIS $4.00.

Approximately 40 mixed oxide materials were prepared and characterized primarily as to their thermal expansion and melting-point behavior. Of particular interest were those materials which were stable, had melting points in excess of 1,400°C, and had low thermal expansions. (auth)

24603 METHOD FOR PRODUCING UO$_2$ LOADED REFRACTORY METALS. Baker, R. D.; Hayter, S. W.; Lewis, H. D. (to United States Atomic Energy Commission). US Patent 3,778,380. 11 Dec 1973. Filed date 31 Oct 1966. 10p.

A finely divided dispersion of UO$_2$ in tungsten or molybdenum is prepared by co-precipitating the metals from mixed aqueous solution with oxine. The co-precipitate thus formed is separated from the solution, dried, calcined, and finally reduced to UO$_2$ and refractory metal. (Official Gazette)

24604 PROCESS FOR PREPARING MULTI-COMPONENT NUCLEAR FUELS. Triggiani, L. V.; Sanchez, M. G. (to W. R. Grace and Co.). US Patent 3,789,013. 29 Jan 1974. Filed date 26 Jul 1971. 12p.

A process for preparing urania-plutonia microspheres by impregnating a matrix of urania with a plutonium salt solution is described. The absorbed plutonium is precipitated in the pores of the urania microspheres with a suitable precipitant. The impregnated microspheres are then washed, dried, and sintered to recover the mixed oxide microspheres. (Official Gazette)

24605 DEFECT STRUCTURE OF ReO$_3$. Colaitis, D.; Lecaille, C.; Lebas, D. (Laboratoire de Chimie des Solides, Paris Cedex, France). Mater. Res. Bull.; 9: No. 3, 295-303(Mar 1974). (In French).

The structure of defect rhenium (VI) oxide was observed by electron diffraction. The defects are analyzed and a structural model is proposed to explain the patterns. The model consists of crystallographically oriented twin-like domains in two orientations. These domains resulted presumably from deformation of a shear structure associated with rhenium loss. (6 figures) (auth)

24606 METHODS FOR OBTAINING SINGLE CRYSTALS OF REFRACTORY COMPOUNDS OF TRANSITION METALS. Gurin, V. N. (Ioffe Inst. of Physics and Tech., Leningrad). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 8, 1147-1163(Aug 1973).

Translated from Izv. Akad. Nauk, SSSR, Neorg. Mater.; 9: No. 8, 1289-1307(Aug 1973).

Comparison of the preparation methods as regards the size of the crystals obtained shows that the best is the liquid-phase method, followed by the gas-phase, solution, and solid-phase (except for carbides). However, such a comparison is not strict, because it does not take account of the quality of the crystals, and applies not to the same but to different compounds, and also does not compare single crystals of all compounds of each class. The absence of criteria other than size for comparing single crystals thus does not permit a strict assessment of the advantages and drawbacks of each method. While recognizing the promise of the liquid-phase method (especially the Verneuil technique and zone fusion), the gas-phase and solution methods are singled out as of interest in connection with the possibility of obtaining single crystals of incongruently melting compounds and creating composite materials. The solution method has some advantage, in that in the preparation of single crystals it can be used to separate them from the solvent matrix in isolated form, whereas in the gas-phase method it is necessary to separate the grown crystals from the substrate, which damages them. In addition, the solution method can be used to obtain composite materials of practically any volume and size, whereas the gas-phase method can give such materials only in films or thin layers. Another advantage of both methods is the possibility of obtaining monocrystalline whiskers of refractory compounds. It is concluded that with the exception of the solution method, which is progressing faster than the others, all the methods of obtaining single crystals of refractory compounds of the transition metals are developing to about the same extent. (auth)

24607 ELASTIC PROPERTIES OF SOLID SOLUTIONS OF ZrC AND NbC AT ROOM TEMPERATURE. Avgustinik, A. I.; Ordan'yan, S. S.; Kudryashcheva, L. V.; Fishchev, V. N. (Leningrad Technological Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 8, 1205-1208(Aug 1973).

Translated from Izv. Akad. Nauk, SSSR, Neorg. Mater.; 9: No. 8, 1358-1361(Aug 1973).

Data on the elastic properties of cubic solid solutions $Zr_{1-x}Nb_xC_y$ with $y = 0.99$ and 0.89 are presented. The data show that the dependence of the moduli of elasticity of these solid solutions on the metal sublattice composition does not obey the additivity law, and that maximal deviations from the latter are observed at a vacancy electron concentration of 8.1 to 8.2 electrons/formula unit. The character of the concentration dependences of the elastic properties of these stoichiometric solid solutions is apparently determined by the value of the screening radius of the excess charge introduced by niobium atoms, and by the elastic deformation of the metal sublattice of the solid solution. The appearance of vacancies in the carbon sublattice reduces the effect of these factors. (auth)

24608 CHEMICAL COMPATIBILITY OF NUCLEAR FUELS WITH CLADDING MATERIALS. Goetzmann, O.; Hofmann, P. (Kernforschungszentrum, Karlsruhe, Ger.). KFK Nachr.; 5: No. 3, 7-13(Nov 1973). (In German).

Investigations in connection with the fast breeder development were carried out using uranium-plutonium mixed oxide and austenitic stainless steel. Carbide and nitride nuclear fuels were also studied along with vanadium alloy cladding materials. The compatibility of the uranium-plutonium mixed oxide is not good as a result of the fission products and the release of oxygen during the irradiation, and will become even more unstable at higher operational temperatures (> 650°C on the inner part of the cladding). There is an alternative solution using carbide or carbonitride fuels. Out-of-pile investigations on oxide fuels with getter addition (niobium or zirconium as oxygen binding materials) resulted in diminishing the attack upon the cladding. The effectiveness of the getter, however, can only be finally assessed after irradiation tests on a fuel rod. (GE)

24609 FORMATION CHARACTERISTICS AND CHEMICAL STABILITY OF COMPLEX NITRIDES OF ELEMENTS OF SUBGROUP III B (SYSTEM Al–B–N). Lyutaya, M. D.; Bartnitskaya, T. S. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 8, 1214-1217(Aug 1973).

Translated from Izv. Akad. Nauk, SSSR, Neorg. Mater.; 9: No. 8, 1367-1371(Aug 1973).

On the basis of chemical and x-ray analyses the crystal chemical nature of complex nitrides formed in the system Al–B–N was examined. It was established that in the system Al–B–N interaction is accompanied by formation of solid solutions (based on AlN) with finite solubility. The chemical stability of the complex nitride $Al_{1.05}B_{0.27}N$ in water, mineral acids of various concentrations, a 40% NaOH solution, and fused NaOH was investigated. The kinetics of the reaction of $Al_{1.05}B_{0.27}N$ with dilute (1: 1) hydrochloric acid at 75, 85, and 95°C were also investigated. At 75 and 85°C, $Al_{1.05}B_{0.27}N$ reacts with hydrochloric acid within a period of 15 to 120 min to form a complex nitride with a higher boron content, soluble aluminum and ammonium salts, and boric acid. At 95°C or above, in addition to these products, BN is observed in the solid residue. (auth)

24610 FORMATION CHARACTERISTICS AND CHEMICAL STABILITY OF COMPLEX NITRIDES IN SYSTEM Ga–B–N. Lyutaya, M. D.; Bartnitskaya, T. S. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 8, 1218-1221(Aug 1973).

Translated from Izv. Akad. Nauk, SSSR, Neorg. Mater.; 9: No. 8, 1372-1376(Aug 1973).

On the basis of chemical and x-ray analyses the crystal chemical nature of complex nitrides formed in the system Ga–B–N was examined. It was established that in the system Ga–B–N interaction is accompanied by formation of solid solutions (based on GaN) with finite solubility. The chemical stability of the nitride $Ga_{0.28}B_{0.85}N$ in water, mineral acids, and a 40% NaOH solution was investigated. The dependence of the reaction of $Ga_{0.28}B_{0.85}N$ with HCl on time at 75°C was also investigated. The reaction of this complex nitride with HCl at 75°C (reaction time 1 h) is accompanied by formation of a complex nitride with a higher boron content than the initial nitride, soluble salts of gallium and antimony, and boric acid. At 95°C (reaction time 1 h), in addition to these products the solid residue contains BN. (auth)

24611 MAGNETIC STRUCTURE OF $LaVO_3$. Zubkov, V.G.; Bazuev, G.V.; Perelyaev, V.A.; Shveikin, G.P. (Institute of Chemistry, Ural Scientific Center, Academy of Sciences of the USSR, Sverdlovsk). Sov. Phys.–Solid State 15: No. 5, 1079-1080 (Nov 1973).

Magnetic susceptibility, x–ray and neutron diffraction measurements were performed on $LaVO_3$. The magnetic moment of V^{3+} ions is determined and a magnetic ordering temperature of 140 ± 2°K is obtained. (AIP)

24612 PARAMAGNETISM OF Nd, Sm, AND Eu ORTHOTANTALATES. Smirnov, S.V.; Rozhdestvenskii, F.A.; Makurin, Y.N.; Krylov, E.I. (S. M. Kirov Ural Polytechnic Institute, Sverdlovsk). Sov. Phys.–Solid State 15: No. 4, 848-848 (Oct 1973).

High sensitivity paramagnetic susceptibility of the high purity orthotantalates of neodymium, samarium and europium is measured in the temperature range 80–300°K and comparison is made with the theoretical curves. (AIP)

24613 ABSORPTION OF MOLECULAR IODINE BY AV-17 ANION-EXCHANGE RESIN. Kazakov, E. V.; Gubanova, L. S. Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 6, 862-863(Jun 1973).

Translated from Zh. Fiz. Khim.; 47: No. 6, 1535-1536(Jun 1973).

The dependence of the sorption of molecular iodine by AV-17 anion-exchange resin on the iodine concentration, supporting electrolyte, and temperature was deduced from laboratory and pilot-plant experimental data. (auth)

24614 ELECTRON-MICROSCOPY STUDY OF OXIDATION OF THE HYDRATE $ReO_2 \cdot 2H_2O$. Colaitis, D.; Lecaille, C.; Lebas, D. (Laboratoire de Chimie des Solides, Paris Cedex, France). Mater. Res. Bull.; 9: No. 3, 211-221(Mar 1974). (In French).

Oxidation of hydrate $ReO_2 \cdot 2H_2O$ is studied by electron microscopy and X-ray powder diffraction. It results in ReO_3. Evidence is given for the existence of a structure Me_2O_5 as an intermediate. The microstructure of single crystals prepared by sublimation under reduced pressure of oxygen, shows planar defects in agreement with the transformation $Re_2O_5 \rightarrow ReO_3$. (13 figures) (auth)

24615 METHOD OF COATING GRAPHITE TUBES WITH REFRACTORY METAL CARBIDES. Wohlberg, C. (to United States Atomic Energy Commission). US Patent 3,778,301. 11 Dec 1973. Filed Date 28 Apr 1967. 2p.

A method of coating graphite tubes with a refractory metal carbide is described. An alkali halide is reacted with a metallic oxide, the metallic portion being selected from the IVth or Vth group of the Periodic Table, the resulting salt reacting in turn with the carbon to give the desired refractory metal carbide coating. (Official Gazette)

24616 QUASIELASTIC ELECTRON SCATTERING IN EuO: A POSSIBLE EXPLANATION FOR THE OBSERVED "PARAMAGNETIC" SPIN-POLARIZED PHOTOEMISSION. Eastman, D.E. (IBM T. J. Watson Research Center, Yorktown Heights, New York 10598). Phys. Rev. B 8: No. 12, 6027-6029 (15 Dec 1973).

Photoemission secondary–electron energy distributions and yield measurements for (100) EuO show that "quasielastic" rather than inelastic electron scattering dominates the photoemission escape process for electrons excited within a few eV of threshold. In this "quasielastic" scattering regime (with a large effective escape depth ~ 50–100 Å), it is suggested that the spin polarization need not be conserved in the photoemission escape process, and that reported "paramagnetic" spin–polarized photoemission at 10°K is possibly due to quasielastic spin–flip scattering. (auth)

24617 PROPERTIES AND STRUCTURE OF THIN FILMS OF NIOBIUM NITRIDE PREPARED BY REACTIVE CATHODE SPUTTERING. I. Preparation and Properties. Spitz, J.; Chevallier, J.; Aubert, A. (CEN, Grenoble, France). J. Less-Common Metals; 35: 181-192(1974). (In French).

The formation of thin films of niobium nitride by reactive sputtering is described. The influence of the various parameters employed in the preparation on the composition, structure and electrical properties (resistivity, temperature coefficient and critical temperature) of these films was investigated. The maximum observed critical temperature (15.85°K) corresponds to the formation of the stoichiometric compound niobium nitride. The existence of a material of composition $Nb_{1-x}N$ ($0 < x < 0.34$) with the same structure as δ-Nb was also observed. (9 figures, 5 tables). (auth)

24618 THERMAL BEHAVIOR OF EPSILON-UO_3. Kozhina, I. I.; Bykov, V. A.; Malinin, G. V.; Yadrintsev, V. B. Vestn.

Leningrad. Univ., Fiz., Khim.; No. 10, 73-76(May 1973). (In Russian).

The thermal dissociation of ϵ-UO_3 to U_3O_8 was investigated by derivatographical and x-ray analyses. It was stated that ϵ-UO_3 decomposed through the intermediate rhombic phase UO_x, where $2.79 \le x \le 2.90$. (auth)

24619 PROPERTIES AND STRUCTURES OF THIN FILMS OF NIOBIUM NITRIDE PREPARED BY REACTIVE CATHODE SPUTTERING. II. Crystallographic Study by Electron Microscopy and Diffraction. Pelissier, J. (CEN, Grenoble, France). J. Less-Common Metals; 35: 193-206(1974). (In French).

Niobium nitride superconductors were obtained by cathodic sputtering of niobium in nitrogen followed by deposition on amorphous carbon substrates. They were examined by transmission electron microscopy and diffraction. In the N/Nb ratio range from 0 to 1.5, this fabrication process leads to thin films of crystallite size 30 to 300 Å. Depending on the N/Nb ratio, the material is either monophase (α-solid solution or σ-superconductor phase) or biphase (niobium and σ-phase). The position and intensity of diffraction rays show that the α-solid solution and σ-phase composition range cannot be described by an equilibrium phase diagram. All thin films were heat treated at 600, 800, and 900°C in the electron microscope; if stable at room temperature their structure changes when the temperature increases. If the N/Nb ratio >1, the σ-phase which appears exhibits a Nb lacunar structure. The diffraction ray position of this structure fluctuates on either side of the theoretical value. Heat treatment at 800°C in the microscope brings back the usual diffraction ray order, possibly because an atomic rearrangement due to migration of lacuna occurs leading to a nearly stoichiometric σ-phase. (13 figures) (auth)

24620 SOLID SOLUBILITY LIMIT OF N IN V AT TEMPERATURES BETWEEN 500 AND 1500°C PRECIPITATION PHENOMENA IN V–N SYSTEM. Hoerz, G. (Max-Planck-Institut fuer Metallforschung, Stuttgart). J. Less-Common Metals; 35: 207-225 (1974).

The solid-solubility limit was determined at 500 to 1500°C using three different methods. The nitrogen saturation concentration, c_s, increases from 2.6 at. % at 500°C to 10.7 at. % at 1500°C where it depends on the temperature, T, in °K according to the equation $c_s = 31.5 \exp(-3800/RT)$. At temperatures between 500 and 1500°C, the hexagonal β-nitride phase, V_2N, is in thermodynamic equilibrium with the α-vanadium–nitrogen solid solution. However, under certain conditions metastable nitride phases form. Aging of V–N alloys containing 8 and 10 at. % N at 500°C results in the formation of an intermediate cubic nitride phase, which is probably also present in aged alloys with lower nitrogen concentrations. This cubic phase has a lattice parameter of 3.105 Å which is about 2% larger than the lattice parameter of the corresponding α-solid solution. During aging of supersaturated α-V–N solid solutions with nitrogen concentrations less than 6 at. % at temperatures below 500°C, the V_2N phase is not formed, even on aging for as long as 1000 h. However, at temperatures between 280 and 350°C, the precipitation of an interstitially ordered phase is observed. This precipitation process is accompanied by age hardening at 300°C. (17 figures) (auth)

24621 THERMODYNAMIC INVESTIGATION OF THE Th–Ru SYSTEM. Kleykamp, H.; Murabayashi, M. (Kernforschungszentrum, Karlsruhe, Ger.). J. Less-Common Metals; 35: 227-233(1974). (In German).

The Gibbs free energy of formation of the intermetallic phases $ThRu_2$, ThRu, Th_3Ru_2, and Th_7Ru_3 which exist in the system was determined by means of emf measurements using galvanic cells with solid CaF_2 electrolyte. The following Gibbs free energies of formation were obtained for the corresponding intermetallic phases in the temperature range 1020 to 1170°K: $ThRu_2$, −11,870 + 3.24 T; ThRu, −15,300 + 3.65 T; Th_3Ru_2, −13,450 + 2.45 T; and Th_7Ru_3, −13,080 + 3.23 T cal (g atom)$^{-1}$. The enthalpy of formation was calculated from existing thermodynamic models and correlated with the experimental results. The stability of the Th–Ru phases were compared with available thermodynamic data for other phases of the Group VIII actinide metals. (21 references) (auth)

24622 SOLID SOLUBILITIES OF OXYGEN, CARBON, AND NITROGEN IN YTTRIUM. Carlson, O. N.; Lichtenberg, R. R.; Warner, J. C. (Ames Labs., IA). J. Less-Common Metals; 35: 275-284(1974).

The solid solubilities were investigated and a partial diagram is proposed for the Y–·YN system. The temperature dependence of the solubility of each solute in α yttrium was fitted empirically to Arrhenius-type equations, and the heats of solution for the coexisting oxide, carbide, or nitride phase were found to be 6.8 ± 0.4, 8.0 ± 1.0, and 11.6 ± 1.3 kcal/mole, respectively. (9 figures) (auth)

24623 RADIATION-INDUCED PARAMAGNETIC CENTERS AS PROBES IN STUDYING OF STRUCTURAL CHANGES OF INORGANIC GLASSES AT HIGH PRESSURE. Brekhovskikh, S. M.; Tyul'kin, V. A.; Polandov, I. N.; Chinenov, G. L. Vestn. Mosk. Univ., Ser. II. Khim.; 14: No. 6, 702-707(1973). (In Russian).

The paramagnetic absorption centers induced in inorganic glasses by ionizing radiation were utilized as probes in EPR studies of structural changes taking place in glasses under the action of high pressure. The glass samples of composition (mole %) 15 Na_2O : 85 SiO_2, 15 Al_2O_3 : 85 SiO_2, 15 Li_2O : 15 Al_2O_3 : 70 SiO_2, and 8.4 Na_2O : 25 B_2O_3 : 66.6 SiO_2 were subjected to quasi-hydrostatic pressure in the range 10 to 100 kbar in 10-kbar steps. The samples were kept during 15 min at constant pressure and then were investigated by EPR technique. There were two sample series of each composition. The first series was treated with radiation before pressing and the second one was treated after pressing. The action of pressure was shown to decrease the space between polyhedrons and to lower the amount of defects of structure but it did not give rise to the coordination rearrangements of lattice. (auth)

24624 OXIDATION OF REFRACTORY COMPOUNDS. I. Silicides of Group IV Metals. Voitovich, R. F.; Pugach, E. A. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 1, 63-70(Jan 1974). (In Russian).

High-temperature oxidation of silicides of transition metals of the IV groups including $TiSi_2$, $ZrSi_2$, and $HfSi_2$ was studied in the air within the temperature range 500 to 1200°C during 5 hr. The thermodynamic calculation of equilibria carried out in the system silicide–oxygen (nitrogen) permits elucidating most probable reactions. Oxidation process was studied using kinetic, x-ray, metallographic, and a method for measuring of the phase microhardness, which permits some assumptions on the possible mechanism of oxidation of the IV group metal silicides to be made. (auth)

24625 INVESTIGATION OF CONDITIONS FOR WB_4 PRODUCTION. Bodrova, L. G.; Koval'chenko, M. S.; Serebryakova, T. I. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 1, 1-4(Jan 1974). (In Russian).

Conditions for production of tungsten tetraboride and domains of its temperature stability are studied within a wide temperature and concentration range. By means of x-ray phase, metallographic, and chemical analyses the tetraboride is established to be monophasic, the presence of a hexagonal structure of one structural type in it is confirmed, the space group being $D_{6h}^{4} - P6_3/mmc$. Physical properties of the compound are determined. (auth)

24626 MECHANISM FOR REDUCTION OF LIQUID MOLYBDENUM. Revyakin, A. V.; Kuznetsov, L. B.; Karpov, Yu. A.; Orlov, V. V. Fiz. Khim. Obrab. Mater.; No. 5, 150-151(1973). (In Russian).

The characteristics of the elimination of oxygen from liquid Mo was investigated by the method of melting in the suspended state. It was shown that when the production of [C] [O] in the melt is higher than 10^{-5} (wt %)^2 the reduction takes place primarily by the interaction of oxygen with carbon. At very low values of the production of [C] [O] the reduction of the concentration of oxygen in the liquid Mo occurs because of the evaporation of atomic oxygen. A production of [C] [O] equal to 10^{-5} (wt %)^2 and an equilibrium pressure for CO_2 of 5 to 7 torr is termed critical for the reduction processes of liquid Mo. (tr-auth)

24627 EFFECTS OF EXPLOSIONS ON REFRACTORY CARBIDES. Samsonov, G. V.; Alekseevskii, V. P.; Bozhko, S. A.; Yarosh, V. V. Fiz. Khim. Obrab. Mater.; No. 5, 108-112(1973). (In Russian).

Hot-pressed samples of the refractory carbides $TiC_{0.98}$, $ZrC_{0.96}$, and $NbC_{0.98}$ were subjected to the effects of collision waves. Explosion pressing was done in steel cylindrical ampules and the pressure at the front of the detonation was 120 and 67 kbar. After the explosion an increase of the microhardness was observed in NbC and an increase of the density of dislocations was observed in all the carbides studied up to 10^{10} cm^{-2}. (tr-auth)

24628 OPTICAL PROPERTIES OF THE SURFACE OF OXIDES DEPOSITED BY THE PLASMA METHOD. Morozov, I. A.; Baranov, V. S.; Petrochenko, A. K. Fiz. Khim. Obrab. Mater.; No. 5, 138-141(1973). (In Russian).

Coatings deposited by the plasma method and having high coefficients of blackness and absorption were investigated. Coatings from oxidized Nichrome powders showed adhesion strength with the steel X18H10T and with the Al–Mn alloy AMts-S good optical stability to the effect of ultraviolet radiation and to different organic solvents. Results were reported of the investigation of the qualitative and quantitative composition of gases released from these coatings at different temperatures. The coatings deposited were Al_2O_3, NiO, Cr_2O_3, ZrO_2, and X20H80. (tr-auth)

24629 THERMAL SHOCK RESISTANCE OF FIRED AND UNFIRED ZIRCONIA REFRACTORIES. Gogotsi, G. A.; Gashchenko, A. G.; Karaulov, A. G.; Rudyak, I. N. (Inst. of Strength Problems, Kharkov). Refractories (USSR) (Engl. Transl.); 14: No. 1-2, 55-60(1973).

Translated from Ogneupory; 14: No. 1, 52-56(1973).

Comparative studies were made of fired and unfired refractories based on zirconium dioxide. The fired refractories are more resistant to cracking. However, the unfired materials possess a higher resistance to the development of cracking which is noted during the registration of surface deformations in the process of destruction of the specimen; this is confirmed by analytical critical evaluation. The determination of the destructive drop in temperatures before the development of the first crack in specimens based on granular bodies should not be considered as a reliable evaluation of the thermal shock resistance of the refractories. A new method was developed for observing the nature of the failure in specimens during thermal loading. (auth)

24630 ELECTRIC QUADRUPOLE INTERACTION IN ZrO_2 AND HfO_2. Yeshurun, Y.; Arad, B. (Bar-Ilan Univ., Ramat-Gan, Israel). J. Phys., C (London); 7: No. 2, 430-438(21 Jan 1974).

The electric field gradients in ZrO_2 and HfO_2 were measured by applying the differential perturbed angular correlation method to the 133 to 482 keV cascade in ^{181}Ta. Results for HfO_2 were compared with previous results. Good agreement was found except for the electric field asymmetry parameter, in which the older result of Gerdau et al (Proc. R. Soc.; A 311; 197 (1969)), rather than the more recent one of Gardner and Prestwich (Can. J. Phys.; 48: 1430 (1970)), was confirmed. Results for ZrO_2 show the electric field gradient to be $(13.3 \pm 0.7) \times 10^{17}$ V cm^{-2} slightly higher than the value of $(12.8 \pm 0.6) \times 10^{17}$ V cm^{-2} obtained for HfO_2. The field asymmetry is 0.335 ± 0.015 for ZrO_2 and 0.348 ± 0.016 for HfO_2. Despite the small difference, the "t" distribution shows, with confidence of better than 99%, that the results for ZrO_2 and HfO_2 are different. (auth)

24631 COMPARISON BETWEEN LaB_6 AND W ELECTRON EMITTERS IN A SEM. Cabrerra, E.; Dingley, D. J. (Univ. of Bristol, Eng.). pp 28-31 of Scanning Electron Microscopy: Systems and Applications 1973. London; Institute of Physics (1973).

From conference on scanning electron microscopy: systems and applications; Newcastle upon Tyne, Eng. (3 Jul 1973).

Lanthanum boride and tungsten were compared as electron emitters for scanning electron microscopes. The beam diameter and specimen current were measured for each of the materials. It was found that for given electron lens settings the probe from the LaB_6 element was two thirds the diameter of the W element, contained twice the current, and had a long lifetime. (UK)

24632 PHYSICAL-CHEMICAL ANALYSIS OF CARBIDE PHASES IN ALLOYS OF REFRACTORY METALS. Vedernikova, V. A.; Popov, A. P.; Postnov, L. M. Metallofizika; No. 47, 102-108(1973). (In Russian).

Calculations were made by thermodynamic methods to obtain the temperature relationships for changes in the standard isobaric-isothermic potentials ($\Delta Z°$) for the formation of carbides from elements up to temperatures of 3500°C. From these relationships temperature limits were established for the stability of various carbides in molybdenum alloys as a function of the content of element forming the carbide in the alloy. Phase analysis of molybdenum alloys containing from 0.06 to 1.4 at. % Zr and from 0.17 to 0.64 at. % C, quenched from temperatures of 1600, 1800, 2000, and 2200°C, showed satisfactory agreement of the results with calculated values. Zirconium carbide was found in those cases where the actual concentration of zirconium was greater than the calculated value necessary for the formation of the carbide ZrC, while the concentration of carbon exceeded its solubility limit in molybdenum at the given temperature. At 1800 to 2200°C the thermodynamically more stable carbide phase was ZrC, while Mo_2C was more stable at the higher temperatures. The temperature limit for stability of the carbide phases ZrC and Mo_2C depends on the concentration of zirconium in the alloy. (SJR)

24633 PHYSICAL ASPECTS OF LIQUID METAL–CERAMIC INTERACTIONS. Nicholas, M. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Ingenieursblad; 43: No. 5, 139-143 (1974).

The theoretical background to physical aspects of liquid metal–ceramic interactions are discussed with particular reference to wetting behavior. The relation between wetting and surface and interfacial energies are described and attempts are made to relate wetting to material parameters. The usefulness of models for predicting the wetting behavior of metal–carbon and metal–alumina systems are discussed. (auth)

24634 CHEMICAL INTERACTIONS BETWEEN CERAMICS AND MOLTEN METALS. Knights, C. F. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Ingenieursblad; 43: No. 5, 133-138(1974).

The degree of aggression of common molten metals towards ceramics is stated and the underlying chemical and thermodynamical principles are reviewed. The metal–ceramic reactions are examined in detail for both oxide and nonoxide ceramics. The general properties of the latter are discussed. (auth)

24635 COMPOUNDS FORMED BETWEEN NIOBIUM PENTOXIDE AND SOME DIVALENT AND TRIVALENT ELEMENT OXIDES AND IN PARTICULAR LANTHANIDE OXIDES. Tilloca, G. (CRNS, Vitry-sur-Seine, France). Rev. Int. Hautes Temp. Refract.; 10: No. 3, 183-196(Jul 1973). (In French).

Small additions of foreign oxides (bivalent and trivalent) to niobium pentoxide leads to the formation of new intermediate compounds which attach themselves to the niobium suboxides Nb_2O_{5-x}. The existence of the additional oxide rich compound, $Mg_5Nb_4O_{15}$, in the Nb_2O_5-MgO system was established. In addition, it was found that Ln_3NbO_7 compounds of $Nb_2O_5-Ln_2O_3$ systems generally attach themselves to two types of structure, and exhibit a variable number of polymorphic transformations at different temperatures dependent upon the nature of the lanthanide element. The cubic form of these compounds admits a certain amount of homogeneity by the dissolution of Ln_2O_3. (FR)

24636 INFLUENCE OF PRECIPITATING ATMOSPHERE ON SINTERING OF ZrO_2 + 12 Mol % Y_2O_3. Thompson, M. A.; Young, D. R.; McCartney, E. R. (Univ. of New South Wales, Kensington, Australia). J. Amer. Ceram. Soc.; 56: No. 12, 648-654(Dec 1973).

Solid solutions of ZrO_2 and Y_2O_3 prepared by decomposing coprecipitated hydroxides exhibited differences in sinterability which did not correlate with variations in particle size, surface area, or purity. These differences were traced to the fact that some of the materials had been exposed to CO_2 during preparation, whereas others had not. The presence of CO_2 during precipitation stabilized the amorphous phase such that energy release and the onset of nucleation and crystal growth occurred at a higher temperature than in Ar-prepared material. It is suggested that during preparation in CO_2 a carbonate complex is formed, which decomposes on calcination, liberating CO_2, some of which is trapped in voids formed by microsintering. The pressure of CO_2 in the voids limits their removal. (auth)

24637 FRACTURE TOUGHNESS OF A PARTIALLY STABILIZED ZrO_2 IN THE SYSTEM $CaO-ZrO_2$. Green, D. J.; Nicholson, P. S.; Embury, J. D. (McMaster Univ., Hamilton, Ont.). J. Amer. Ceram. Soc.; 55: No. 12, 619-623(Dec 1973).

The room-temperature fracture behavior of partially stabilized ZrO_2 (PSZ) in the system $CaO-ZrO_2$ was investigated. Fracture energy was measured using standard single-edge-crack and work-of-fracture techniques. Attempts were made to relate the fracture toughness parameters to the microstructure of the material. Stable crack propagation was always observed; a model is proposed to explain these observations on the basis of the formation of a microcrack zone at the tip of a propagating crack. The occurrence of initial stable crack propagation is explained in terms of an increase in microcrack zone size. The possibility that crack stability results from testing geometry superimposed on the microcracking stability is also discussed. (auth)

24638 CRYSTAL STRUCTURE AND MAGNETIC STRUCTURE OF TbOOH. Christensen, A. N. (Univ. of Aarhus, Denmark); Quezel, S. J. Solid State Chem.; 9: No. 3, 234-241(Mar 1974).

The monoclinic modification of terbium oxide hydroxide, TbOOH, was prepared using hydrothermal technique. The crystal structure was investigated by three-dimensional single-crystal x-ray analysis and was refined to a conventional R-value of 8.1%. The space group is $P2_1/m$, No. 11, with $a = 6.04$ Å, $b = 3.69$ Å, $c = 4.33$ Å, and $\beta = 109.0°$. The terbium atom is seven coordinated with oxygen atoms, and the structure is not hydrogen bonded. The compound is antiferromagnetic with a Néel temperature of 10°K. Neutron diffraction powder patterns were measured at 300 and 4.2°K. The magnetic super lattice reflections were indexed on the basis of the monoclinic unit cell with the dimensions $a_M = 2a$, $b_M = b$, $c_M = c$, and $\beta_M = \beta$, where a, b, c, and β are the dimensions of the chemical unit cell. The structure contains two independent magnetic atoms. A noncolinear antiferromagnetic arrangement of the spins describes the magnetic structure. The spin at one atom has an angle of 43° with the ac plane and the projection of the spin on the ac plane has an angle of 59° with the a axis. The spin on the other atom has an angle of −43° with the ac plane, the projection having the same angle of 59° with the a axis. (7 tables) (auth)

24639 STRUCTURAL STUDIES IN THE $Li_2MoO_4-MoO_3$ SYSTEM. Part I. Low-Temperature Form of Lithium Tetramolybdate, $L-Li_2Mo_4O_{13}$. Gatehouse, B. M.; Miskin, B. K. (Monash Univ., Clayton, Australia). J. Solid State Chem.; 9: No. 3, 247-254(Mar 1974).

$L-Li_2Mo_4O_{13}$ crystallizes in the triclinic system with unit-cell dimensions $a = 8.578$ Å, $b = 11.450$ Å, $c = 8.225$ Å, $\alpha = 109.24°$, $\beta = 96.04°$, $\gamma = 95.95°$, and space group $P\bar{1}$, $Z = 3$. The calculated and measured densities are 4.02 g/cm^3 and 4.1 g/cm^3 respectively. The structure was solved using three-dimensional Patterson and Fourier techniques. Of the 2468 unique reflections collected by counter methods, 1813 with $I \geq 3\sigma(I)$ were used in the least-squares refinement of the model to a conventional R of 0.031 ($\omega R = 0.038$). $L-Li_2Mo_4O_{13}$ is a derivative of the V_6O_{13} structure with oxygen ions arranged in a fcc type array with octahedrally coordinated molybdenum and lithium ions ordered into layers. (26 references) (auth)

Metals and Alloys

Refer also to abstracts 24585, 24593, 24594, 24598, and 26419.

24640 (GEMP-29-B) HIGH-TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT NO. 29, PART B. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 6 Dec 1963. Contract AT(40-1)-2847. 95p. Dep. NTIS $6.75.

Declassified 21 Sep 1973.

Research progress is reported in programs on oxidation-resistant cladding for fuel elements, reactor moderators, reactor reflectors, shielding materials, refractory ceramic fuels, materials for direct energy conversion, and graphite fuel materials. (JRD)

24641 (HEDL-TME-73-5(Vol.1)) HEDL QUARTERLY TECHNICAL REPORT, JULY, AUGUST, SEPTEMBER 1973. Volume 1. Materials Technology. Evans, E. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Oct 1973. Contract AT(45-1)-2170. 225p. AT.

Research and development work is summarized in chapters on applied research, materials engineering, component fabrication, and fuels. A separate abstract was prepared for each chapter. Additional information is included in appendixes containing applied research data, materials engineering data, component fabrication data, and sodium technology data. (JRD)

For abstracts of individual chapters see: 24595–24597 and 24807.

24642 PROTECTIVE COATINGS ON METALS. Volume 5. Samsonov, G. V. (ed.). New York; Plenum Publishing Corporation (1973). 285p. $35.00.

Translation of Zashchitnye Pokrytiya na Metallakh by Eric Renner.

Forty-nine papers are presented under the following section headings: diffusion saturation and formation of coatings; carbidizing and siliciding; nitriding and aluminizing; titanium and copper plating; chromizing; multicomponent diffusion coatings; and properties of protective coatings. Separate abstracts were prepared for 18 of the papers. (DLC)

For abstracts of individual chapters see: 23990, 24651–24660, 24685, 24686, and 24755–24759.

Corrosion and Erosion

Refer also to abstracts 23987, 24633, 24634, and 26523.

24643 (AD-766679-5) CONTAMINATION HARDENING OF SU-31 AND FS-85 COLUMBIUM ALLOYS. Herring, R. B. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). Apr 1973. 22p. (AMMRC-TR-73-18). NTIS $2.75.

A study was made of the contamination hardening of SU-31 and FS-85 Nb alloys which results when samples are exposed in air temperatures of 1400 to 2600°F. Diffusion coefficients for the principal contaminant, calculated from hardening profiles, are in good agreement with data previously reported for diffusion of oxygen in pure Nb. It is concluded that the hardening in the alloys is principally due to the absorption and diffusion of oxygen from the air. Activation energies were 22.5 kcal/mol for SU-31 and 20.3 kcal/mol for FS-85. Based on the measurements of this study, SU-31 has a higher resistance to contamination hardening than FS-85 by about a factor of two. (auth)

24644 (AD-768153-9-GA) OXIDATION OF COLUMBIUM AND COATED COLUMBIUM ALLOYS. Levy, M.; Falco, J. J.; Herring, R. B. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). Jul 1973. 29p. (AMMRC-TR-35). NTIS $3.00.

Oxidation of the Nb alloys FS-85, SU-31, and a complex disilicide coating/SU-31 and FS-85 alloy systems were studied at 1400 to 2700°F at 1 atm and 50 cm/s flow rate of air. For studies of the uncoated alloys, the flow rate and pressure dependence of the alloys were also investigated. Methods included thermogravimetric measurements of oxidation rates and studies on reacted specimens by means of x-ray diffraction, metallographic techniques, and electron microprobe analysis. Two anomalies in the temperature dependence of the oxidation rate were observed for both alloys and were related to the oxides formed. The SU-31 alloy has the best oxidation resistance. The oxidation mechanism of the alloys is discussed along with the mechanism of protection afforded by the complex disilicide coating system. The coating did not fail after 1000 hours of oxidation. (auth)

24645 (CONF-740205-4) GASEOUS OXIDATION OF URANIUM ALLOYS. Cathcart, J. V. (Oak Ridge National Lab., Tenn. (USA)). 1973. 37p. Dep. NTIS $4.00.

From conference on physical metallurgy of uranium alloys; Vail, Colorado, USA (12 Feb 1974).

The gaseous oxidation of uranium and its alloys is a complex process. Material transport across the oxide scale occurs predominately by anion diffusion, leading to the development of large stresses in the oxide. The thermodynamic stability of UO_2 is such that the oxygen potential in a compact layer of UO_2 is so low that many constituents of uranium alloys remain unoxidized and are found embedded in the UO_2 scale. The high-temperature oxidation properties of uranium and its alloys are reviewed in light of the above parameters. Materials covered include binary alloys of uranium with Nb, Zr, Mo, V, Ti, Al, and Cu as well as the ternary system U–Nb–Zr and other more complex formulations. Details of oxygen diffusion in UO_2 are discussed. Evidence is given for stress generation during oxidation, and mechanisms for stress generation and relief are described. (25 figures, 52 references) (auth)

24646 (GEAP-13919-3) LMFBR HEAT EXCHANGER MATERIALS DEVELOPMENT PROGRAM. Quarterly Progress Report No. 3, December 1972–February 1973. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Mar 1973. Contract AT(04-3)-893. 36p. Dep. NTIS $4.00.

Results of research on heat exchanger materials directed at the development of design data on the effects of environment on properties of materials are summarized. The primary variables in this program are the probable normal and off-normal environments to which a steam generator or intermediate heat exchanger will be exposed during its manufacture, shipping, installation, and operation. During each of these stages, the component may be subjected to environmental hazards that can seriously affect its performance. These hazards include slow degradation of properties during normal operation (e.g., decarburization, carburization), rapid degradation of properties during off-normal operation (e.g., leakage of water into the sodium) and stress corrosion cracking before or after installation. In the current phase of the program the materials being studied includes all the candidate heat exchanger materials (Type-304 and Type-316 stainless steels, 2¼ Cr–1 Mo, 9 Cr–1 Mo, and Incoloy-800). Temperature range, thermal gradient, and the chemistry of sodium and water have been selected to simulate both normal and off-normal environments of large fast reactors. (auth)

24647 (JAPFNR-136) MASS TRANSFER TESTS OF SUS304, A STRUCTURAL MATERIAL FOR FAST BREEDER REACTORS, IN SODIUM. I. Results of Continuous Exposing Experiment for 2500 Hours in a Material Test Loop. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center). Sep 1972. 87p. (PNC-N-941-72-18). Dep. NTIS (U. S. Sales Only) $6.50.

Development work on a sodium cooled fast breeder reactor is reported. An interim report on sodium mass transfer and corrosion test program is presented. The experimental results from tests in the material testing loop are reported. Operating conditions for the mass transfer test include an exposure time of 2,500 h, test temperatures between 600 and 390°C, and cold trap temperature of 200°C (oxygen content can be estimated 10 ~ 20 ppM). In all specimens inserted in hot leg positions, selective leaching of Cr, Ni, and Fe was observed, and weight loss grew with the increase in total corrosion. These results show that the nature of the relative movements of alloy constituents in the tested stainless steel specimens will be related to temperature and also sodium velocity. It was observed that the surface of ferritic phase due to the loss of Cr and Ni was formed. A depth of perturbation layers in composition was about 7 microns. (auth)

24648 (RFP-2162) CORROSION STUDIES IN PLUTONIUM–NITRIC–HYDROFLUORIC SOLUTIONS. Terada, K.; Macki, J. M.; Dringman, M. R.; Cash, D. L. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 8 Feb 1974. Contract AT(29-1)-1106. 8p. Dep. NTIS $4.00.

Several alloys were evaluated as possible construction material in chemical processing equipment for plutonium at Rocky Flats. Corrosion studies were made of these alloys in solutions obtained from a production storage tank. The principal components of these solutions were HNO_3, HF, and Pu. Results showed relative concentrations of these components can significantly affect corrosion rates. Of the alloys tested, Inconel 690 exhibited the lowest corrosion rates in the process solutions. E-Brite 26-1 also showed corrosion resistance greater than 304L stainless steel. (auth)

24649 (SLA-74-5037) STRESS CORROSION CRACKING OF URANIUM ALLOYS. Magnani, N. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 23p. (CONF-740205-1). Dep. NTIS $3.00.

From conference on physical metallurgy of uranium alloys; Vail, Colorado, USA (12 Feb 1974).

Literature data show that two types of stress-corrosion cracking occur in uranium alloys; transgranular and intergranular. Two completely different types of mechanisms have been proposed for these modes. The transgranular cracking is attributed to a mechanical mechanism dealing with stresses generated by the reaction product while the intergranular cracking is attributed to either H_2 embrittlement or an anodic dissolution process. The data show that the intergranular cracking occurs more rapidly, and when conditions are such that both types of cracking can occur, the intergranular mode usually predominates. Since intergranular cracking initiates more easily than the transgranular type it has been the most common type. Conditions which favor intergranular cracking include high alloy addition levels, environments containing H_2O and/or Cl-ions. High temperature aging has been found to eliminate stress corrosion cracking in some alloys, or at least reduce the susceptibility. This behavior is most likely due to the elimination of the intergranular cracking path (prior γ grain boundaries). Transgranular stress corrosion cracking has been observed in U alloys when precracked specimens are used. In uranium alloys with low alloy additions this mode is observed in all environments tested, but in the alloys with higher addition levels the mode is observed only in air tests. While the details of the cracking mechanism may not be well understood, enough is now known about uranium alloy stress corrosion cracking to permit the safe use of the alloys under the proper conditions. A few points should be kept in mind: (1) As the strength of an alloy increases the susceptibility to stress-corrosion cracking increases. This has been observed in the U–Nb and U–Ti systems. (2) As the corrosion resistance increases the susceptibility to cracking increases. This seems to hold true of all of the uranium alloys. (3) Care should be taken in the application of uranium alloy stress corrosion data because of difference in behavior observed between smooth and precracked specimens. (auth)

24650 EFFECTS OF Mo AND Al ON HOT CORROSION (SULFIDATION) BEHAVIOR OF EXPERIMENTAL Ni BASE SUPERALLOYS. Morrow, H. III; Sponseller, D. L.; Kalns, E. (Climax Molybdenum Co. of Michigan, Ann Arbor). Met. Trans.; 5: No. 3, 673-683(Mar 1974).

The hot corrosion behavior of a series of wrought nickel-base superalloys containing approximately 13 wt% Cr was studied as a function of molybdenum content from 0 to 8 wt% Mo in each of four Al + Ti levels (3% Al, 4½% Al, 6% Al, and 1% Al-3½% Ti). Specimens were tested in a burner rig with a 5 ppM sea salt concentration in a 1% sulfur diesel fuel burned at a 30:1 air-to-fuel ratio and were cycled between 1600 or 1800°F and room temperature every 50 h during a 1000-h test. It was found that molybdenum significantly reduced the amount of hot corrosion attack at 1600°F for the three aluminum-containing series of alloys. For the titantium-containing series of alloys tested at 1600°F and all alloys exposed at 1800°F, molybdenum exerted little influence on hot corrosion behavior. Aluminum was found to markedly increase sulfidation rates at both 1600 and 1800°F for all molybdenum levels. Titanium appeared to be beneficial to the hot corrosion resistance of these alloys at 1600°F and detrimental at 1800°F. It was further noted that 1600°F represented a more severe sulfidation condition than 1800°F under these test conditions. (auth)

24651 REACTIONAL DIFFUSION DURING OXIDATION OF TUNGSTEN ALLOYS IN AN ATMOSPHERE WITH A HIGH CONCENTRATION OF NITROGEN. Lazareva, I. Yu.; Prokoshkin, D. A., Vasil'eva, E. V.; Skotnikov, S. A. (Inst. of Metallurgy, Moscow). pp 57-60 of Protective Coatings on Metals. Vol. 5. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1973).

The kinetics and mechanism of oxidation were investigated for W alloys with Ti, V, Nb, Ta, or Re (up to 50%) in air (1 atm) with varying N partial pressures (590 to 711 mm Hg). Increasing the N pressure also increases the oxidation for all alloys except W–30% Nb or Ta, W–Re, and highly alloyed W–V alloys. The N contents in the oxide scales were determined. During the dissolution of N in the scale, O^{2-} ions are replaced by N^{3-} ions. (DLC)

24652 MECHANISM OF THE FORMATION OF ZIRCONIUM CARBIDE ON GRAPHITE FROM A METALLIC MELT. Asaturov, S. A.; Gorbunov, N. S. (Inst. of Physical Chemistry, Moscow). pp 94-97 of Protective Coatings on Metals. Vol. 5. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1973).

Experiments show that carbide formation occurs prior to dissolution of C in molten Zr. The variation of the carbide coating thickness, microhardness, and lattice constant was studied. Results indicate that the growth of the carbide layer is due to diffusion of C. (DLC)

24653 SURFACE NITRIDING OF VANADIUM. Samsonov, G. V.; Kaplina, G. S. (Inst. of Problems of Materials Science, Kiev). pp 105-109 of Protective Coatings on Metals. Vol. 5. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1973).

Electrolytic V was nitrided in N at 800 to 1200°C. VN is formed with a layer of α solid solution of N in V below it. Growth of the layer is parabolic with time and is limited by N diffusion. The microhardness of the V nitride layer is 1850-1960 kg/mm^2 on the outer side and 1400-1500 kg/mm^2 on the inner side. The activation energy of N diffusion in nitride is 18,900 cal/mole. (DLC)

24654 COMBINED SATURATION OF ALLOY ZhS6-K WITH Al AND Ta AND Al AND Nb. Veksler, Yu. G.; Kupriyanov, I. L. (Urals Polytechnical Inst., Sverdlovsk, USSR). pp 170-174 of Protective Coatings on Metals. Vol. 5. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1973).

In order to improve the heat resistance of the Ni–Cr alloy ZhS6-K, the slip method was used to apply Al–Ta and Al–Nb diffusion coatings. Highest heat resistances were obtained for Al alloys containing 70% Ta or 60% Nb. (5 figures) (DLC)

24655 MECHANISM OF ELECTROLYTIC SATURATION OF STEELS WITH B, Cr, Al, AND Zr. Pasechnik, S. Ya.; Korotkov, V. D.; Lokatosh, O. V.; Afanas'ev, A. A.; Obednin, L. F.; Khabarov, A. V.; Borsyakov, A. S. (Voronezh Technological Inst., USSR). pp 175-181 of Protective Coatings on Metals. Vol. 5. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1973).

The effect of current density on the formation of phases during borochromizing and boroaluminizing was shown. The possibility of boron–zirconium plating was demonstrated; optimum processing conditions were determined. The effect of reversing the polarity of the current during electrolysis on the depth of diffusion coatings was established. The effect of dynamic loads under abrasive wear conditions on the wear resistance of diffusion coatings was also studied. (5 figures, 4 tables) (auth)

24656 BOROALUMINIZING WITH PASTES CONTAINING A SMALL AMOUNT OF ALUMINUM. Prosvirin, V. I.; Gerasimov, L. V. (Riga Inst. of Civil Aviation Engineers). pp 182-190 of Protective Coatings on Metals. Vol. 5. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1973).

Boroaluminizing and boriding of carbon and stainless steels with pastes containing 2 to 10% Al produces high-quality coatings with high hardness, heat resistance, and abrasive wear resistance. The small 2% Al amount in the paste favors the diffusion of B in steel Kh18N9T and the formation of boride phases in the diffusion coating. The B distribution has a minimum at some depth, corresponding to the austenite zone with borides, with boride phases on both sides of it. The diffusion coating contains FeB, Fe_2B, and $(Ni,Fe)B_{12}$. Boroaluminizing of steel St. 3 produces a more ductile diffusion coating than simple boriding. (7 figures) (DLC)

24657 RESISTANCE OF DIFFUSION COATINGS IN MELTS OF BRASS AND ALUMINUM. Zemskov, G. V.; Kogan, R. L.; Shestakov, A. I.; Shevchenko, I. M. (Odessa Polytechnical Inst.). pp 213-217 of Protective Coatings on Metals. Vol. 5. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1973).

The purpose of the work was to find diffusion coatings for protecting machine parts against wetting and reaction with liquid brass and Al. Steels 45 and 3Kh2V8 were diffusion coated with Al, Cr, B, Ti, and Zr, and the resistance to brass and Al melts were judged. Highest resistance was exhibited by boroaluminized coatings applied successively. (DLC)

24658 INCREASING THE HEAT RESISTANCE OF NIOBIUM ALLOYS. Petrovskaya, L. M.; Ponomarenko, E. P.; Kolomytsev, P. T.; Potapov, V. D. pp 226-231 of Protective Coatings on Metals. Vol. 5. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1973).

Diffusion coatings of Ti, Cr, and Si were applied singly and in combination to the Nb alloy VN-4(8.5 to 10.5% Mo, 1 to 2% V). Among the single-component coatings, Si shows the highest heat resistance (weight gain 0.045 g/cm^2 after 84h at 1200°C) but has a tendency to crack and low resistance to temperature changes. The heat resistance is best for Ti–Cr–Si coatings (0.0005 g/cm^2 after 84h at 1200°C). (DLC)

24659 PROTECTING NIOBIUM AND TANTALUM AGAINST CARBURIZATION. Zhunkovskii, G. L.; Evtskhok, T. M. (Inst. of Problems of Materials Science, Kiev). pp 232-235 of Protective Coatings on Metals. Vol. 5. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1973).

Boron layers were deposited on pure Nb and Ta by saturation and their reactions with the metal and carbon materials (graphite and soot) investigated at up to 2000°C. Results show that the layer thickness first increases, reaches a max, and then decreases. The lower borides NbB and TaB are formed at the expense of the diborides, and carbides are also formed. The use of boride layers as barriers is thus limited by the temperature at which reaction with the metallic substrate begins. (DLC)

24660 RESISTANCE TO SCALING AND TO ABRASION OF Cu DIFFUSION COATED WITH Al, Ni, AND Zr. Vavilovskaya, N. G.; Timonina, L. G. (Siberian Metallurgical Inst., Novosibirsk, USSR). pp 243-246 of Protective Coatings on Metals. Vol. 5. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1973).

Saturation (diffusion coating) of Cu with Al, Ni, and/or Zr increases the scale resistance and abrasion resistance. Best scale resistance was obtained if Al and Zr were combined, while wear resistance is highest for aluminized samples. (DLC)

24661 INFLUENCE OF RESIDUAL GASES AND O_2 ON ACTIVATION ENERGY FOR SURFACE SELF-DIFFUSION OF W IN PRESENCE OF HIGH ELECTRIC FIELDS. Vanselow, R.; Wang, J. L. (Univ. of Wisconsin, Milwaukee). J. Less-Common Metals; 35: 245-258(1974).

Two buildup stages could be distinguished during the heating of tungsten field emitters at various residual gas pressures, p, while an electric field, F, was applied: (a) buildup around the $\langle 111 \rangle$ poles and (b) buildup around $\{100\}$ planes. A plot of log p versus Q_F, the activation energy for surface self-diffusion with field, indicated a linear relation with a positive slope for $\{100\}$ buildup and a linear relation with a negative slope for $\langle 111 \rangle$ buildup. The value of Q_F also, is a linear function of F, indicating a permanent dipole migration mechanism. In the presence of oxygen $\langle 111 \rangle$ buildup occurred predominantly. The Q_F values match the pressure dependence for residual gas $\langle 111 \rangle$ buildup. It could be determined: Q_F (W-atom) = 1.9 eV/particle for $\overline{F}$ = 25 MV/cm, $Q_{F=0}$ (dipole) = 4.8 eV/particle at $P_{residual} = 4 \times 10^{-9}$ torr, and an effective dipole moment of $\mu \simeq 6D$. The increase of Q_F $\{100\}$ with increasing residual gas pressure is proposed to be due to pinning by carbon. The final buildup form ($\{110\}$, $\{100\}$, and $\{112\}$) is discussed in comparison with other single-crystal growth forms of tungsten. (6 figures, 5 tables, 49 references) (auth)

24662 CORROSION OF CHROMIUM, IRON, AND STAINLESS STEEL IN LIQUID SODIUM. Barker, M. G.; Wood, D. J. (Univ. of Nottingham, Eng.). J. Less-Common Metals; 35: 315-323 (1974).

The corrosion products $NaCrO_2$ and Na_4FeO_3 were observed on the surfaces of chromium, iron, and stainless steel after exposure to liquid sodium at 600°C and above. The products were identified by x-ray diffraction without the removal of the covering sodium layer. (6 figures) (auth)

24663 CORROSION TESTS ON THE ZIRCALOY-2 ALLOY IN WATER AT HIGH TEMPERATURE. Mandru, G.; Popescu, E.; Munteanu, A. Rev. Chim. (Bucharest); 24: No. 11, 909-911(Nov 1973). (In Rumanian).

Results of corrosion tests carried out with Zircaloy-2 in alkaline aqueous mediums at a temperature of 300°C and a pressure of 90 at. % are presented. The corrosion kinetics in the mediums were examined. Metallographic studies revealed the morphology of the hydrides formed during the corrosion process. (auth)

24664 OXIDATION–REDUCTION RATE OF VANADIUM AND TITANIUM IONS ON ROTATING DIOXIDE ELECTRODE. Antonov, S. P.; Stepanenko, V. G. (Inst. of General and Inorganic Chemistry, Kiev). Ukr. Khim. Zh.; 39: No. 11, 1181-1184(Nov 1973). (In Russian).

The character of the polarization during oxidation-reduction of V and Ti ions was clarified by the rotating dioxide electrode method. It was established that a chemical interaction takes place between the products of the associated reactions of ion reduction and hydrogen release and ion oxidation and oxygen release. The relative stoichiometric coefficients in the electrode reactions were determined. It was shown that the mechanism of the chemical interaction depends on the nature of the electrode surface. (tr-auth)

24665 REACTIONS IN THIN METAL FILMS BOMBARDED BY THE HIGH INTENSITY ELECTRON MICROSCOPE BEAM. Berting, F. M. (Uniroyal, Inc., Middlebury, CT); Lawless, K. R. Advan. X-Ray Anal.; 16: 217-228(1973).

From applications of x-ray analysis conference; Denver, Colorado, USA (2 Aug 1972). See CONF-720801-.

The electron microscope beam provides energy for a variety of reactions between the sample and the surrounding gas or the surface impurities. It is generally not possible to control exactly the temperature of the sample or the pressure and content of the gas or impurity in contact with it. Thus, results, while useful in a general way, cannot always be predicted or reproduced. The similarity in the appearance of the oxides, nitrides, and carbides of tantalum (and niobium) produced by irradiation in the electron beam indicates the need for caution in identifying the reaction products of irradiation by morphology alone. The structures obtained by electron beam irradiation are similar to the oxide domains produced by heating tantalum films in oxygen at 300°C in the electron microscope in the in situ study of oxidation. (auth)

24666 IMPROVEMENT OF THE RESISTANCE TO CORROSION BY SUPERHEATED STEAM OF INCOLOY ALLOY 800 TUBE MATERIAL BY SURFACE DEFORMATION TREATMENT. Leistikow, S.; Kraft, R. (Kernforschungszentrum, Karlsruhe, Ger.). Werkst. Korros.; 25: No. 1, 12-25(Jan 1974). (In German).

Specimens of Incoloy 800 (%, 45.8 Fe, 31.7 Ni + Co, 20 Cr, low additions of Cu, Mn, Al, Ti, and Si), having undergone a surface deformation treatment (rolling, bending, sand blasting, needle peening, and emery grinding) were exposed to superheated steam (500 and 1,000 h; 600 and 620°C; 1, 70 and 145 atm; 0.03 and 3.5 m/s). The weight loss measured has been evaluated as a function of the surface quality. It has been shown that the corrosion losses are inversely proportional to the degree of deformation, corrosion being reduced by 95 to 96% at 90% deformation. In this context the bending deformation, sand blasting and needle peening are most efficient, while rolling or emery grinding give rise to deformations in a very thin surface layer which have no "self-healing" properties. The composition of the corrosion products depends on the degree of deformation: increasing deformation gives rise to a decrease of the iron content, while the contents of nickel, chromium, and manganese are increased; this phenomenon is responsible for the protective effect which is due to the formation of chromium oxide coatings. (GE)

24667 SILICON SOLUBILITY IN MOLYBDENUM AND REFRACTORY SILICATE MELTS–MOLYBDENUM CRUCIBLES INTERACTION. Lungu, S.; Beleuta, I. L.; Popescu, F. (Institutul de Fizica Atomica, Bucharest). Rev. Int. Hautes Temp. Refract.; 10: No. 3, 173-175(Jul 1973).

The failure of molybdenum crucibles in which UO_2–SiO_2 vitroceramics are melted (in the 2300 to 2500°C region) appears to be due to a too rapid heating (>10 to 15°C/minute) of the bath. An approximation based on thermodynamic data (liquidus and solidus) on the formation of a compound between Mo and Si is used to demonstrate that local equilibrium can result in a liquidus phase at lower temperatures than those of the general diagram. The failure mechanism is thus determined from the type of equilibrium corresponding to the heating rate. Data obtained using fast neutron activation are in agreement with the equilibrium diagram and the behavior predicted for local equilibria. (FR)

24668 DEVELOPMENT OF PITTING-RESISTANT Fe–Cr–Mo ALLOYS. Streicher, M. A. (E. I. du Pont de Nemours and Co., Inc., Wilmington, DE). Corrosion; 30: No. 3, 77-91(Mar 1974).

Because of the resistance of iron-chromium stainless steels to chloride stress corrosion, this alloy system was used as a base for developing superior resistance to various forms of corrosion by means of alloying with molybdenum, nickel, and the six metals of the platinum group. The effects of these alloying elements were evaluated by accelerated laboratory tests for pitting, intergranular, general, and stress corrosion. The optimum ductility and resistance to pitting, intergranular, and stress corrosion were found for an alloy of Fe–28% Cr–4% Mo with carbon not exceeding 0.010% and nitrogen below 0.020% (C + N < 0.025%). This alloy resists pitting and crevice corrosion in 10% $FeCl_3 \cdot 6H_2O$ at 50°C with six crevices on the specimen surfaces, and it resists all intergranular attack on a welded specimen in the boiling ferric sulfate–50% H_2SO_4 test. Additon of 2% Ni to this alloy extends its general corrosion resistance in oxidizing and organic acids to boiling 10% H_2SO_4 and 1% HCl, in which it is also self-repassivating. The nickel addition makes the alloy subject to stress corrosion cracking (SCC) in the boiling 45% $MgCl_2$ test, but not in the NaCl wick test, which more nearly simulates plant exposures and cracks 18Cr–8Ni stainless steel. Additions of small amounts of any of the six platinum metals, e.g., 0.020% Ru, also make the 28Cr–4Mo alloy passive in boiling 10% H_2SO_4. But only ruthenium, iridium, and osmium do this without impairing pitting resistance in halide solutions. For self-repassivation, 0.50% Ru is required, and this amount makes the alloy subject to stress corrosion in the boiling 45% $MgCl_2$ test, but not in the wick test. (auth)

Preparation and Fabrication

Refer also to abstracts 24025, 24596, 24831, 25986, 26025, 26117, 26118, and 26261.

24669 (AEC-tr-7496) FABRICATION OF CLAD TUBE FOR FAST REACTOR FUELS. Lallemand, J. P. (International Atomic Energy Agency, Vienna (Austria)). 1973. Translation of SM-173/VII-16. (CONF-730726-25). 23p. Dep. NTIS $4.00.

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973).

The stages in industrial production of stainless steel cladding for fast reactors are reviewed. Information is included on inspection of as-received steel, hot working, tube fabrication, quality control, and finished product checks. (JRD)

24670 (AWRE-O-2-74) DENSITY VARIATIONS IN POROUS HOT PRESSINGS OF HIGH DIAMETER TO LENGTH RATIO. Baldwin, M. P. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Jan 1974. 17p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 Pence.

Results are presented to the density profile through the thickness of porous beryllium powder compacts hot pressed by a "limited ram travel" method to overall densities in the range 86 to 96% theoretical. The geometries investigated were 14 in.-diameter 0.9 in.-thick, and 16 in.-diameter 1.8 in.-thick. It is shown that both compact geometries consist of zones of high density variation near the top and bottom surfaces, together with a middle zone of relatively uniform density. The high density variation zones were attributed to frictional effects and it was concluded that to achieve a uniform density product the pressing geometry had to allow the friction affected material to be discarded. (auth)

24671 (BARC-693, pp 1-30) PREPARATION OF PURE MATERIALS SECTION. 1973.

Activities primarily concerned with the development of processes and preparation of about 20 high purity materials (elements and compounds) required in the electronics industry and in scintillation technology are reported. The Special Materials Plant (SMP) in Hyderabad is being set up to produce these materials on a large scale. Regular production of a few of these materials has commenced at the SMP and it is expected that regular production will be initiated before the end of the year. Scientists who were responsible for the developmental work on the preparation of these high purity materials were assigned to the SMP to initiate production and train the personnel. Efforts were also continued on fabricating and testing of prototype equipment required for the SMP. Work was continued on preparation of high purity materials as well as other special compounds. Work in the section was diversified with the initiation of development programs on the production of compound semiconductors such as GaAs, GaAsP, InSb, CdS, ZnS, and various arsenic selenide tellurides. Work has also been initiated on the preparation of phosphors and liquid lasers. Activities were continued in the development of processes for the extraction of rare metals of interest from different indigenous mineral sources. This is being done with a view to achieve substitution of some of the raw materials which are now being imported to produce high purity materials required. Besides these activities, researches in inorganic chemistry are being conducted with a view to obtain (i) relevant data on the stability and structure of metal complexes or on processes which might be useful in devising better methods of separation and hence purification, and (ii) basic understanding of mechanisms of reactions of metal complexes. (auth)

24672 (DP-MS-72-74) DEVELOPMENT OF HIGH PERFORMANCE URANIUM METAL FUELS FOR SAVANNAH RIVER REACTORS. McDonell, W. R.; Sturcken, E. F. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). 1973. Contract AT(07-2)-1. 32p. (CONF-731101-52). Dep. NTIS $3.75.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

The technological evolution of high performance uranium metal fuel elements for Savannah River Plant (SRP) reactors is described, with emphasis on the metallurgical development required to achieve satisfactory irradiation behavior. Fuel element design changes, embodying principally increased heat transfer area, were accompanied by improved methods for bonding the uranium cores within aluminum cans. Anisotropic growth of the fuel element during irradiation caused by texture of the core was eliminated by development of beta heat-treating processes using oil-quenching. Cavitational swelling was controlled by minor alloying additions to the uranium metal. The resulting fuel elements are capable of sustaining high exposures in SRP reactors. (auth)

24673 (GU-5308) MIXED-OXIDE FUEL PELLET FABRICATION AND FUEL ROD ASSEMBLY FOR DRESDEN 1, BATCH 7 RELOAD. Hower, L. D. Jr. (Gulf United Nuclear Fuels Corp., Elmsford, N.Y. (USA)). Jan 1974. 39p. Dep. NTIS $4.00.

The fuel composition is UO_2–2.3 wt% PuO_2. A total of 99 Zircaloy-2-clad fuel rods were produced containing approximately 20,000 pellets. Process data and information are included on fuel pellet fabrication, quality control, fuel rod assembly, fuel powder chemical and physical properties, and Pu recycle pellets. (JRD)

24674 (IS-3319) STUDY OF THE REDUCTION OF DYSPROSIUM OXIDE WITH LANTHANUM AS A METHOD FOR PRODUCING HIGH PURITY DYSPROSIUM METAL. Sanden, B. L.; Spedding, F. H. (Ames Lab., Iowa (USA)). Feb 1974. Contract W-7405-eng-82. 53p. Dep. NTIS $4.75.

An investigation was carried out to evaluate the preparation of dysprosium metal by a reduction-distillation method. Lanthanum metal was used as the reductant. Maximum yields of the as-reduced metal were typically 70 to 75% when a reduction temperature of 1650°C was used. If the reaction was run long enough to obtain a 50% of theoretical yield, a purer product was obtained in a much shorter length of time. The yield did not improve when a reduction was performed at 1750°C. The yield of dysprosium metal was rather insensitive to the amount of excess lanthanum reductant used. A 10% stoichiometric excess of lanthanum was found to give optimum yields, with no further increase in yield when 20 and 30% excess reductant was used. The as-reduced metal product contained typically 1% by weight lanthanum and 1000 ppM by weight oxygen. When the metal was purified by sublimation at 1100 to 1300°C one sublimation lowered the lanthanum level to 650 ppM and the oxygen to 50 ppM. Two additional sublimations yielded a product containing 20 ppM oxygen and 30 ppM or less lanthanum. A temperature of 1300°C was most desirable since greater sublimation rates were possible with good purification of products. Dysprosium containing 1000 ppM oxygen was sublimed at 1200, 1300, and 1400°C resulting in products which had only slight differences in oxygen levels. Dysprosium containing 1% by weight lanthanum was sublimed at 1100 and 1300°C with the 1100°C sublimation giving better lanthanum separation. When extremely pure dysprosium is desired this method is the most successful to date, but the very high purity is obtained at the expense of high yields. (auth)

24675 (ORNL-tr-2723) INCREASE IN SERVICE RELIABILITY OF 12Kh1MF STEEL PIPES OF STEAM SUPERHEATER. Krutasova, E. I.; Vostretsov, L. S.; Novitskaya, G. M. Translated by Martha Gerrard from Elek. Sta.; No. 8, 27-31(1972). 7p. Dep. NTIS $3.00.

The optimum regime for mechanical-thermal processing of 12Kh1MF steel is 12-15% cold plastic deformation followed by tempering at 680 to 700°C. Steel 12Kh1MF thus processed has the following properties: High-temperature strength increased up to 40% (compared with steel processed by the MRTU-14-4-21-67 regime), with long-term operation of the steel at the same tension increased 6- to 8-fold; the long-term plasticity remains at an adequate level; stability of structure and properties are retained at temperatures up to 565°C; short-term mechanical properties correspond to MRTU-14-4-21-67 specifications. (auth)

24676 (ORNL-tr-2791) PREPARATION AND PROPERTIES OF SINTERED URANIUM. Hofman, A. (Institute of Nuclear Research, Warsaw (Poland)). Dec 1965. Translation of INR-666/XIV/PS. 8p. Dep. NTIS $3.00.

Uranium powder prepared by means of hydrogenation and hydride decomposition is a very fine-grained product (grain size below

5 μ); it is pyrophoric and thus has to be formed wet or in an argon atmosphere. Cold pressing of uranium powder at a pressure of 10 ton/cm^2 and sintering at a temperature of 1120°C resulted in the highest density realized by this method, i.e. about 18.46 g/cm^3. The structure of the sintered uranium is coarse-grained with a particle size of the order of 500 μ. These conditions of uranium pressing and sintering may be used for the preparation of uranium alloys with a small addition of the alloying elements. (auth)

24677 (SLL-74-203) PRODUCTION OF Er AND Pd FLAKES WITH SUBMICRON THICKNESSES. German, R. M.; Ham, V. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1974. Contract AT(29-1)-789. 13p. Dep. NTIS $3.00.

Erbium and palladium powders were milled into submicron thick flakes with aspect ratios of 25 and 300, respectively. A reduced speed attrition milling process especially developed for this purpose is described. The properties of the resultant flakes make them attractive for hydrogen solid storage applications. The techniques described are applicable to a large category of metals. (auth)

24678 (Y-DA-5260) LIQUID-PHASE SINTERED TUNGSTEN ALLOYS. Snyder, W. B. Jr.; Ludwig, R. L.; Northcutt, W. G. Jr. (Oak Ridge Y-12 Plant, Tenn. (USA)). 28 Mar 1973. Contract W-7405-eng-26. 25p. (CONF-730472-1). Dep. NTIS $3.25.

After a brief review of liquid-phase sintering and its use in fabrication, the materials W–5% Ni and W–3.5% Ni–1.5% Fe are discussed in detail. The effects of different W powders (lamp grade, high green strength, and reprocessed) on the mechanical properties of the sintered alloys are shown. The embrittlement problem and ways of increasing the strength and ductility are considered. Ta, Ru, Co, and Cr additions were investigated; Ru was found to increase the flow stress while still retaining the ductility. (15 figures) (DLC)

24679 (Y-DA-5323) MELTING OF URANIUM ALLOYS. Cadden, J. L.; Jessen, N. C. Jr.; Lewis, P. S. Jr. (Oak Ridge Y-12 Plant, Tenn. (USA)). 28 Dec 1973. Contract W-7405-eng-26. 149p. (CONF-740205-3). Dep. NTIS $9.50.

From conference on physical metallurgy of uranium alloys; Vail, Colorado, USA (12 Feb 1974).

Uranium alloys fall under the category of reactive materials and hence must be melted under relatively inert conditions. Selecting the most suitable method for melting depends primarily upon the tolerance of the final product for impurities and the degree of alloy segregation. To some extent, the form of the melting stock and final ingot shape may also influence the method chosen. Several methods commonly used in melting uranium alloys as well as some less exploited techniques are discussed. Emphasis is placed on melting parameters, impurity pickup, and alloy segregation. (auth)

24680 (Y-DA-5333) JOINING OF URANIUM ALLOYS. Turner, P. W.; Johnson, L. D. (Oak Ridge Y-12 Plant, Tenn. (USA)). 18 Dec 1973. Contract W-7405-eng-26. 68p. (CONF-740205-7). Dep. NTIS $5.50.

From conference on physical metallurgy of uranium alloys; Vail, Colorado, USA (12 Feb 1974).

The technology for joining dilute (up to 10 weight percent) alloys of uranium is reviewed. Information is presented for alloys with the following elements: aluminum, chromium, hafnium, iridium, iron, molybdenum, nickel, niobium, silicon, tantalum, thorium, titanium, vanadium, tungsten, and zirconium. The principal welding methods are electron beam and gas tungsten-arc, with a lesser amount of work on friction, laser, and plasma-arc welding being reported. Also discussed are solid-state bonding, brazing, electrochemical joining, resistance welding, and less commonly used arc processes. Safety considerations, cleaning methods, and joint preparation are included. The effects of alloying elements on weldability are described and mechanical test data that would be useful to the designer of uranium alloy weldments are included. Data are presented on impurity elements often found in uranium-base alloys and their effect on weldability. Work using computerized multipass procedures on heat-treatable uranium–titanium alloys demonstrates the future possibilities in uranium alloy welding. (auth)

24681 (Y-DA-5353) PRECIPITATION HARDENING IN URANIUM-RICH URANIUM–TITANIUM ALLOYS. Ammons, A. M. (Oak Ridge Y-12 Plant, Tenn. (USA)). 19 Dec 1973. Contract W-7405-eng-26. 111p. (CONF-740205-2). Dep. NTIS $7.75.

From conference on physical metallurgy of uranium alloys; Vail, Colorado, USA (12 Feb 1974).

Although the addition of titanium is an effective means of strengthening uranium, careful control of casting, homogenization and heat treatment are necessary to optimize the mechanical properties of the alloy. Some gains in mechanical properties are realized in the as-cast alloys, however, quenching the alloys from the γ-phase produce even higher strengths and elongation through the formation of the lenticular structure α_2'. The properties of the alloys are quench rate sensitive and quenching produces high residual stresses in the alloy. The γ-quenched alloy is a supersaturated precipitation hardenable alloy and aging treatments produce further increases in strength by precipitation of the intermetallic compound U_2Ti. This precipitate forms as coherent Guinier–Preston zones in the α-uranium matrix with the following orientation relationship: $(010)_{\alpha\text{-U}} \parallel (01\bar{1}0)_{U_2Ti}$ and $[100]_{\alpha\text{-U}} \parallel [0001]_{U_2Ti}$. (auth)

24682 RARE METALS IN NAME: MATERIALS OF THE FUTURE IN REALITY. Braaten, O. (Elkem-Spigerverket A/S, Oslo). Kjemi; 33: No. 5, 11-13(31 May 1973). (In Norwegian).

Recent developments in the exploitation and industrial production of Zr, Ti, Ga, Re, and Y in Norway are reviewed. Commercial production of Zircaloy cladding tubes for reactor fuel has been started by Raufoss Ammunisjonsfabrikk and the same firm is developing similar processes for the production of titanium tubes for the aircraft and chemical industries. On the other hand prospecting for rhenium has not led to the discovery of commercially interesting deposits. CERN has enquired in Norway as to possible deliveries of gallium. Only one Norwegian firm, Vigeland Bruk, produces a significant amount, but for the large aluminum industry it may prove an interesting byproduct. Yttrium in the form of very high purity Y_2O_3 is produced by Megon in a pilot plant with a capacity of 5 ton/y. The process has been developed by Institutt for Atomenergi. (NO)

24683 PREPARATION OF MOLECULAR CERMETS FROM RARE-EARTH AND YTTRIUM PERTECHNETATES. Zaitseva, L. L.; Konarev, M. I.; Sukhikh, A. I.; Velichko, A. V.; Romanov, V. S.; Shishkov, N. V.; Chebotarev, N. T. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 8, 1266-1268(Aug 1973).

Translated from Izv. Akad. Nauk, SSSR, Neorg. Mater.; 9: No. 8, 1423-1426(Aug 1973).

Molecular cermets of a rare-earth oxide and technetium were obtained by reducing rare-earth and yttrium pertechnetates in a current of hydrogen, followed by sintering at 1600°C. The microstructure of cermets of the rare-earth oxide–technetium type was investigated; the mean grain size of the oxide phase is 1.0 to 5.3 μ. The microhardness of technetium in molecular cermets is 230 to 250 kg/mm^2. (auth)

24684 MOLYBDENUM EXTRACTION FROM MOLYSULFIDE. Mukherjee, T. K.; Gupta, C. K. (Bhabha Atomic Research Center, Trombay, India). Met. Trans.; 5: No. 3, 707-713(Mar 1974).

Two different extraction processes were used to extract molybdenum metal from technical grade molysulfide. The first one involved two steps: open-aluminothermic reduction of molysulfide in presence of potassium chlorate as a thermal booster for obtaining massive molybdenum, and its conversion to high purity molybdenum metal by fused-salt electrorefining in a $KCl-K_3MoCl_6$ electrolyte. The second approach aimed at direct recovery of molybdenum from molysulfide-carbon anodes by fused-salt electrolysis again in the $KCl-K_3MoCl_6$ electrolyte. In the electrorefining of the thermit metal, a metal recovery of 85% and an average current efficiency of 70% were achieved at 0.6 to 0.75 V using a cathode current density of 7499 to 8332 A/m^2, a bath temperature of 1173°K and an electrolyte with 7.5% molybdenum content. With the same electrolyte and under almost similar conditions, electrolysis with molysulfide carbon anodes at a cathode current density of 14,998 to 15,554 A/m^2 gave a metal recovery of 82%, at an average current efficiency of 50%. Both the routes yielded molybdenum of comparable purity. (auth)

24685 PHASE AND STRUCTURAL TRANSFORMATIONS DURING CHEMICOTHERMAL TREATMENT. Kontorovich, I. E. (Moscow Evening Metallurgical Inst.). pp 36-42 of Protective Coatings on Metals. Vol. 5. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1973).

Chemicothermal aging, which is the name given to the process occurring when Fe alloys are nitrided (saturated with N and then cooled slowly), is discussed. The possibility of chemicothermal aging in other cases besides N was studied using Fe alloys saturated with Be; the nature of the beryllides precipitated was determined. Chromization effects were also investigated. Results indicate that surface saturation of Fe alloys with C also makes it possible to obtain a hardness as high as that of nitrided surfaces. The precipitation hardening process is irreversible. (DLC)

24686 KINETICS OF Nb AND Nb_3Sn DEPOSITION FROM THE GASEOUS PHASE. Ugol'nikova, T. A.; Moiseev, A. I. (Inst. of Physics of Metals, Moscow). pp 199-203 of Protective Coatings on Metals. Vol. 5. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1973).

The kinetics of the deposition of Nb and Nb_3Sn on Pt or W by H reduction of their chlorides was studied relative to the substrate temperature, gas composition, and H flow. Results show that the Nb deposition rate is independent of the $NbCl_5$ content, that Nb_3Sn deposition rate remains constant in a wide range of Nb and Sn chloride contents, and that both depend on substrate temperature. (DLC)

24687 SINTERING OF POWDERS AND CHEMICO-THERMAL TREATMENT OF METAL SURFACE DURING HEATING WITH LASER BEAM. Gazuko, I. V.; Krapivin, L. L.; Mirkin, L. I. (Moscow State Univ.). Porosh. Met., Akad. Nauk Ukr. SSR; No. 1, 27-30(Jan 1974). (In Russian).

Mixtures of powders and metals with powder coatings were irradiated using laser pulses. The production of solid solutions such as iron–carbon and iron–tungsten and compounds such as iron–silicon and aluminum–niobium, and simultaneous solid solutions along with chemical compounds is shown to be possible. The physical mechanism of the observed phenomena involving the mixing of components in liquid state with the subsequent hardening is considered. (auth)

24688 MICROSECTIONING TECHNIQUE FOR VANADIUM. Pelleg, J. (Atomic Energy Commission, Beer Sheva, Israel). J. Less-Common Metals; 35: 299-304(1974).

By a combined anodizing and stripping technique, thin sections can be removed from vanadium metal. A uniform, thin oxide film can be grown on the vanadium metal in an acetone–benzoic acid–sodium tetraborate solution during anodization, which is then removed in aqueous NH_4OH (10%). The thickness x of the metal removed in ångstrom units is given by $x = 103.2 + 12.5$ V, V being the voltage applied. The application of such a sectioning technique for constructing penetration profiles in diffusion studies is of special interest, since contribution from diffusion along lattice defects can be recognized and eliminated. Details of the experimental technique by which the films are grown and stripped are given. (auth)

24689 FLUX-CORED WIRE UPS NUCLEAR CONSTRUCTION PACE. Elec. World; 181: No. 3, 44-45(1 Feb 1974).

Duke Power Co. is applying flux-cored continuous welding during construction of the McGuire reactors in North Carolina. Experience had been gained during construction of the Oconee Nuclear Station, in South Carolina. Good results are the product of the characteristics of the welding wire being put to its best use by the well-trained efficiency-conscious corps of welders. The mechanisms of welding with the flux-cored wire had been taught to the welders by Chemetron. (MCW)

24690 METHOD FOR PRODUCING EVAPORATION INHIBITING COATING FOR PROTECTION OF SILICON–GERMANIUM AND SILICON–MOLYBDENUM ALLOYS AT HIGH TEMPERATURES IN VACUUM. Chao, P. J. (to United States Atomic Energy Commission). US Patent 3,783,031. 1 Jan 1974. Filed date 4 Jun 1971. 8p.

A method is given for protecting Si–Ge and Si–Mo alloys for use in thermocouples. The alloys are coated with silicon to inhibit the evaporation of the alloys at high temperatures in a vacuum. Specific means and methods are provided. (5 fig) (Official Gazette)

24691 FLUXLESS ALUMINUM BRAZING. Werner, W. J. (to United States Atomic Energy Commission). US Patent 3,782,929. 1 Jan 1974. Filed date 23 Jun 1972. 6p.

This invention relates to a fluxless brazing alloy for use in forming brazed composites made from members of aluminum and its alloys. The brazing alloy consists of 35–55% Al, 10–20% Si, 25–60% Ge; 65–88% Al, 2–20% Si, 2–18% In; 65–80% Al, 15–25% Si, 5–15% Y. (Official Gazette)

24692 FINE-GRAINED ZIRCONIUM-BASE MATERIAL. Van Houten, G. R. (to United States Atomic Energy Commission). US Patent 3,782,924. 1 Jan 1974. Filed date 26 Nov 1962. 4p.

A method is described for making zirconium with inhibited grain growth characteristics, by the process of vacuum melting the zirconium, adding 0.3 to 0.5% carbon, stirring, homogenizing, and cooling. (Official Gazette)

24693 ELECTROLESS COATING OF MOLYBDENUM ON STAINLESS STEELS. Koger, J. W.; Lawrence, E. J. (to United States Atomic Energy Commission). US Patent 3,783,014. 1 Jan 1974. Filed date 18 Jan 1972. 4p.

An adherent coating of molybdenum on stainless steel is obtained by contacting the stainless steel with a molten fluoride salt containing from 1 to 5 wt % MoF_6. (Official Gazette)

24694 CONTINUOUS VACUUM CASTING METHOD. Guichard, C.; Soret, J. C. (Societe Industrielle de Combustible Nucleaire, Veurey, France). Rev. Met. (Paris); 70: No. 9, 577-583(Sep 1973). (In French).

From autumn meeting on metallurgy; Chatenay-Malabry, France (2 Oct 1973).

A process is described which associates continuous casting and vacuum refining in order to continuously project the cast product into the air. The process is used to cast 33 mm diameter uranium rods and 45 mm diameter graphite core (23 mm) uranium rods for French graphite-gas reactors. A description is given of the industrial equipment used for the continuous vacuum casting process together with the operational characteristics of the different parts of the casting equipment. The results obtained are presented with the economics or productivity of the process. (FR)

24695 WELD HEAT-AFFECTED ZONES IN Ti–6Al–2Nb–1Ta–1Mo. Gordine, J. (Dept. of Energy, Ottawa). Weld. J. (N. Y.); 53: No. 3, 117s-124s(Mar 1974).

The heat-affected zone in Ti-6211 was studied using Gleeble synthetic specimen techniques. Impact results from synthetic specimens indicated that poor notch ductility can be anticipated in certain regions of the heat-affected zone that are heated above 2000°F. Metallographic examination showed the structure in this region to be α^1-martensite in coarse former β grains. The cooling conditions that govern the formation of the α^1-martensite were established and attempts were made to improve the impact strength in the heat-affected zone by reducing the cooling rate. No significant improvement could be obtained and it was concluded that the poor impact properties were a result of the coarse-grained structure developed in this region. Poor impact properties were also obtained in synthetic specimens that were heated through weld thermal cycles having peak temperatures of 1000 to 1200°F. No change in microstructure was observed and it was concluded that this was probably a result of an ordering reaction. Good correlation was established between actual heat-affected-zone microstructures and simulated structures produced in the Gleeble. (auth)

24696 METALS RESOURCES: MOLYBDENUM. Miller, J. R. J. Metals; 25: No. 8, 31-32(Aug 1973).

Data and information on production and consumption of Mo are presented. It is noted that reserves of Mo in the countries outside the Russian sphere are 9000 million pounds and production in these countries was 164 million pounds in 1970 and expected to increase to 262 million pounds in 1980. No basic changes are expected in Mo process technology during the 1970–80 decade. (JRD)

Properties, Structure, and Phase Studies

Refer also to abstracts 25987, 26023, 26085, 26216–26220, 26228, 26260, 26276, 26519, and 26525.

24697 (AD-763820) PROPERTIES OF DILUTE AND CONCENTRATED MAGNETIC ALLOYS. Final Report. Sarachik, M. P.; Smith, F. W. (City Coll., New York (USA). Dept. of Physics). 2 Apr 1973. 10p. (AFOSR-TR–73-1115). NTIS $3.00.

Various experiments such as susceptibility, resistivity, magnetoresistance, thermoelectric power, and specific heat, were performed on selected alloy systems, both dilute and concentrated. Results were obtained, some of them useful in testing existing theory, and others instrumental in prompting further theoretical work on Kondo systems and on spin fluctuations. The work on concentrated alloys showed clear evidence for the existence of giant magnetic clusters, and recent theoretical work has accounted for these measurements in terms of intra- and inter-cluster interactions. (auth)

24698 (AD-765329-8) DEVELOPMENT OF ULTRAFINE-GRAIN-SIZE TITANIUM WITH IMPROVED MECHANICAL PROPERTIES. Final Report. May, R. C. (Franklin Inst. Research Labs., Philadelphia, Pa. (USA)). Apr 1973. Contract N00019-72-C-0253. 73p. (FIRL-F-C– 3277). NTIS $3.50.

Modified Kahn-type tear tests and fatigue crack propagation tests were conducted to evaluate the effect of strengthening by grain refinement and/or cold deformation on the toughness of alpha titanium. In addition to grain size and cold work, the effects of interstitial content, texture, and substitutional alloying were evaluated. For unalloyed materials, the tear strength and the fatigue crack propagation rates were generally improved with increasing yield strength, independently of the chemical and structural conditions. Ti–6Al–4V and Ti–5Al–2.5 Sn alloys showed reduced tear strengths. Measurement of the unit propagation energy during tear testing was found to be very sensitive to differences in chemistry and structure. (GRA)

24699 (AD-766680-3) LOCALIZATION OF STRAIN IN A DEFORMING SHEET. Azrin, M.; Wonsiewicz, Bud C. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). Apr 1973. 19p. (AMMRC-TR-73-20). NTIS $2.75.

A method for obtaining numerical solutions to the Marciniak-Kuczynski analysis for the localization of strain in a deforming sheet is presented. It is found that deformation can start either as plane-strain flow at a local weakness, or as simultaneous yielding in this region and the remainder of the sheet. A third deformation mode, which is not included in the above analysis, occurs when the imposed stress state is that of plane strain. A discussion and equations describing this behavior are also included. The necessity of considering the metallurgical behavior and its influence on the mechanical properties used in the analysis is discussed. (auth)

24700 (AD-766681-1) MECHANICAL PROPERTIES AND FRACTURE TOUGHNESS OF Ti−6Al−2Sn−4Zr−Mo. Hickey, C. F. Jr.; DeSisto, T. S. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). May 1973. 14p. (AMMRC-TR-73-23). NTIS $2.75.

Data were obtained for Ti−6Al−2Sn−4Zr−2Mo in two heat-treated conditions. Solution temperatures of 1650 and 1790°F followed by an aging treatment at 1100°F were selected. Variables considered include specimen location and orientation, plus notch orientation for the toughness specimens. Light microscopy, x-ray, and fatigue crack growth patterns were also studied and correlated with the above parameters. The most significant finding in this investigation was the enhancement in toughness parameter data with increased heat treatment temperature. Impact and precracked Charpy (W/A) values were approximately doubled and plane-strain fracture toughness values were increased roughly 17%. (auth)

24701 (AD-766682-9) FRACTURE TOUGHNESS MEASUREMENTS OF THREE TITANIUM ALLOY EXTRUSIONS. DeSisto, T. S. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). Jul 1973. 17p. (AMMRC-TR-73-31). NTIS $2.75.

Plane strain static K_{Ic} and dynamic K_{Id} measurements were obtained on 3-in. dia. titanium alloy extrusions which received a 5.9 : 1 reduction followed by air cooling. The alloys investigated were Ti−6Al−6V−2Sn, Ti−8Mo−8V−2Fe−3Al, and Ti−11.5Mo−6Zr−4.5Sn (Beta III). Compact tension specimens were used to obtain K_{Ic} measurements and precracked standard Charpy V-notched specimens were used to obtain K_{Id} measurements. The highest K_{Ic} and K_{Id} values were obtained from the Beta III extrusion while the lowest K_{Ic} and K_{Id} values were obtained for the Ti−8Mo−8V−2Fe−3Al extrusion. Good agreement was found to exist between K_{Ic} values obtained from precracked Charpy V-notch specimens and compact tension specimens. (auth)

24702 (AD-767551-5-GA) DETERMINATION OF BASIC STRENGTH PROPERTIES OF Ti−8Mo−8V−2Fe−3Al SHEET. Curll, C. H.; Lum, P. (Army Materials and Mechanics Research Center, Watertown, Mass. (USA)). Jun 1973. 16p. (AMMRC-PTR-73-7). NTIS $2.75.

Examination of the various room-temperature mechanical properties of the beta-alloy Ti−8Mo−8V−2Fe−3Al sheet (Ti-8823) in the stabilized heat-treated condition indicates that this material may represent a cost-effective replacement for mill-annealed Ti−6Al−4V sheet (Ti-64). With approximately equal elastic moduli, the strength properties are higher for the stabilized Ti-8823 than for the mill-annealed Ti-64. The examination also indicates that for improved strength properties of solutionized, cold-rolled, and aged Ti-8823, either a greater amount of cold working or longer aging time is probably needed. ASTM Standards E-9 and E-238 cite typical sheet specimens and fixtures for compression and bearing testing, but do not cite any standard specimens or fixtures. Therefore, in this study the development of a compression and hearing test fixture compatible with the null-balance, servo-measuring system inherent in the test equipment was required. (auth)

24703 (AEC-tr-7486) AUSTENITIC STAINLESS STEEL DEFORMATION UNDER COMPLEX STRESSES: CREEP UNDER A PROGRESSIVE LOAD AT HIGH TEMPERATURES: CREEP UNDER THERMAL STRESS. Blanc, B.; Calvet, J. N.; Le Bret, P.; Petrequin, P. (International Atomic Energy Agency, Vienna (Austria)). 1973. Translation of SM-173/4. (CONF-730726-16). 23p. Dep. NTIS $4.00.

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973).

In the course of a study of high temperature creep deformations of AISI 316 stainless steel under variable stresses, it was found that conventional creep data with constant stress and temperature make it possible to anticipate the behavior of materials—with certain hypotheses. Consequently, simulation tests of stress conditions in service can be limited solely to short experimental checks. In the particular case of creep under a progressive load, where there was a choice between time or strain-hardening hypotheses for damage calculation, it was shown experimentally that the latter hypothesis was the more representative of deformation mechanism. This result enables better use to be made of the usually large volume of conventional creep data. Such steps are currently facilitated and rendered possible by modern means of calculation. In the case of creep under thermal stress, the validity of the calculations which forecast negligible effect by these stresses under the conditions imposed was confirmed. (auth)

24704 (AEC-tr-7515) SOME CONCLUSIONS ABOUT THE STRUCTURE AND PHYSICAL PROPERTIES OF UAl_4. Jesse, A. Translated from J. Nucl. Mater.; 37: 340-342(1970). 6p. Dep. NTIS $3.00.

The structural and physical properties of UAl_4 prepared by smelting Al and U (67 wt %) at 1550°C under a protective gas after a 500-h homogenization of the pulverized and thoroughly mixed material under high vacuum are described. A product results with about 84 vol % UAl_4 and the rest Al and UAl_3. The results of the x-ray study of the material are tabulated. The thermal expansion, microhardness, thermal conductivity, specific electrical resistance, and temperature coefficient were also measured and the results are reported. (JSR)

24705 (ANL-8009) ANL LOW-CYCLE FATIGUE STUDIES: PROGRAM, RESULTS, AND ANALYSIS. Weeks, R. W.; Diercks, D. R.; Cheng, C. F. (Argonne National Lab., Ill. (USA)). Nov 1973. Contract W-31-109-eng-38. 70p. AT.

The purpose, scope, results to date, and future plans of the ANL low-cycle fatigue testing program are reviewed. Results for Types 304 and 316 stainless steel are presented in both tabular and graphical formats, and their significance is discussed in relation to LMFBR component design. The preliminary results of cumulative damage studies are also reported, and detailed plans for future testing are included. (auth)

24706 (CEA-CONF-2449) PROGRESS REALIZED IN THE AUTOMATIC CONTROL BY ULTRASONICS OF AUSTENITIC STAINLESS STEEL WELDS USING FOCALIZED TRANSDUCERS. Saglio, R.; Roule, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Technologie). [nd]. 4p. (In French). (CONF-730606-8). Dep. NTIS (U. S. Sales Only) $3.00.

From seventh international conference and exhibition on nondestructive testing; Warsaw, Poland (4 Jun 1973).

The ultrasonic control of austenitic stainless steel welds is almost impossible with classical transducers because of the reflections at the grain boundary which gives a signal-to-noise ratio that is too weak. The use of focalizing transducers makes it possible, on one hand, to improve the signal-to-noise ratio by a value which can reach 40 db and, on the other hand, because of the fineness of the ultrasonic beam obtained, to dimension the faults with a precision sharply superior to that obtainable with a plane transducer. Examples of the industrial realization of automatic devices using focalizing transducers for control of angle welds, T welds, and streak welds on small tubes are presented. A new method is available for the ultrasonic control in the case of very absorbant materials or materials having a strong reflectivity at the grain boundaries. The dimensioning of faults becomes more reliable and more precise. (tr-auth)

24707 (CEA-CONF-2456) REVIEW OF THE METALLURGY STUDIES MADE AT THE CEA ON THE IN-SERVICE BEHAVIOR OF FUEL ELEMENTS OF THE GRAPHITE-GAS CHAIN. Blanchard, P.; Millet, P.; Courcon, P.; Truffert, J.; Faussat, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Div. de Metallurgie et d'Etude des Combustibles Nucleaires). 22 May 1973. 43p. (In French). (CONF-730912-3). Dep. NTIS (U. S. Sales Only) $4.25.

From international conference on physical metallurgy of reactor fuel elements; Berkeley, England, UK (2 Sep 1973).

After a brief review of the three types of fuel elements used in the EDF reactors, the principal steps in the metallurgical studies of these elements are outlined. It is shown how the growth, creep, and swelling of U can be reduced to acceptable levels by controlling the mechanisms of each of the three elementary modes of deformation and by controlling their eventual interaction. It is shown how in the case of Bugey-1 Reactor annular fuel elements the development of a metallurgical bond between fuel and cladding has made it possible to limit considerably the consequences of a cladding rupture. The principles of the studies now underway on the release of fission gas usually occluded in the uranium are outlined. The problems caused by the diffusion of Pu into the Mg–Zr claddings and the solutions proposed are discussed. The rupture mechanisms of the centerers, which assure the placement of the casings in the graphite, are described. (tr-auth)

24708 (CEA-CONF-2526) INFLUENCE OF VARIOUS METALLURGICAL PARAMETERS AND NEUTRON FLUX ON CREEP OF ZIRCALOY 4 CLADDING TUBES. Frenkel, J. M.; Weisz, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Technologie). [nd]. 6p. (CONF-731004-6). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on nuclear fuel performance; London, UK (15 Oct 1973).

The creep strength of cladding tubes is one of the significant parameters in the design of fuel elements of light water reactors. Internal pressure creep tests were made on Zircaloy 4 tubes of some twenty batches differing in manufacturing method. It was noticed that creep strength varied widely with the annealing temperature and the cold work level of the tube. A high annealing temperature had a beneficial effect on the transverse creep strength, whereas the effect of high cold working was unfavorable. Completely annealed tubes produced the best results. This annealing effect is linked to an increase in the anisotropy of the material presumably resulting from modifications in texture. Internal pressure creep tests under neutron flux were made in a wide range of temperature and flux (330 to 385°C, 4×10^{13} to 2×10^{14} n/cm^2.s, E > 1 MeV). At high temperature and high flux significant creep acceleration was still observed. Even under flux, the effect of the annealing temperature on the transverse creep strength was very clear. (auth)

24709 (CNLM-4444) REVIEW OF NIOBIUM–1 ZIRCONIUM ALLOY LONG-TERM PROPERTIES. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 26 Feb 1963. Contract AT(30-1)-2789. 31p. Dep. NTIS $3.75.

Declassified 17 Sep 1973.

A review is presented of the Nb–1 Zr alloy long-time mechanical properties data, stress analysis procedures, and structural testing program being applied in the Lithium Cooled Reactor Experiment (LCRE) design. Design of a high reliability reactor system requires obtaining an accurate assessment of materials mechanical properties data. With this knowledge, allowable stress and strain levels can be established from which component configuration requirements can be established and applied in the design phase. During the early stages of the LCRE design, Nb–1 Zr alloy 1000 hour data were extrapolated using a Larsen–Miller parameter to provide the basis for the 10,000 hour preliminary design. A conservative criterion of one half 10,000 hour rupture stress was used for the reactor pressure vessel and internal components and one quarter 10,000 hour rupture stress was used for external components. Conservatism was similarly applied in estimating temperature and pressure environments. It should be pointed out that the design criteria function as a "pressure vessel code" and were written in the spirit of the code, meeting the needs of the LCRE operating temperatures considering such factors as creep, and creep rupture, and thermal cycling. The criteria are intended to establish a conservative margin between operating states of stress and strain, and failure by fracture or excessive deformation. These margins are chosen to yield an efficient use of material and a structure of light weight and ample reliability. Illustration of the conservatism applied is the reactor pressure vessel design temperature of 2000°F while the actual operating temperature of the pressure vessel will be in the 1600 to 1900°F range. It is shown that conservatism of the assumptions and design criteria applied in the LCRE design yield a fundamentally sound and reliable reactor and reactor system in consideration of the most recent Nb–1 Zr alloy mechanical properties data available. (auth)

24710 (CONF-720129-) PROCEEDINGS OF SYMPOSIUM ON METAL FRACTURE, GRENOBLE, FRANCE, JANUARY 19–21, 1972. (Societe Francaise de Metallurgie. Section Regionale du Sud-Est). 1972. 346p. (In French and English).

Fourteen papers presented at the symposium are included. The papers contain information on materials toughness, elastic-plastic properties, radiation effects on austenitic steels, mechanical properties of Nb, fracture of U–10 Mo alloys, x-ray diffraction techniques, fracture properties of Ti–O and Zr–O alloys, fracture modes of Al–5% Cu alloys, corrosion of U–10 Mo alloys, mechanisms of rupture, fatigue crack propagation, relations of orientation with fracture of Al alloys, and fracture properties of martensitic steel. (JRD)

24711 (CONF-730583-(Absts.)) DANISH SOCIETY FOR PHYSICS AND CHEMISTRY OF CONDENSED MATTER SUMMER MEETING, MUNKERBJERG, DENMARK; MAY 31–JUNE 2, 1973. Abstracts. (Danish Atomic Energy Commission, Risoe. Research Establishment). 1973. 35p.

Abstracts of invited and contributed papers are given. Sessions were devoted to the following subjects: magnetism, defects, superconductivity, amorphous structures and liquids, semiconductors and semimetals, diffraction, sputtering and ion implantation, and metals. (RWR)

24712 (CONF-740205-8) RECENT OBSERVATIONS OF PHASE TRANSFORMATIONS IN A U–Nb–Zr ALLOY. Vandermeer, R. A. (Oak Ridge National Lab., Tenn. (USA)). 1973. 59p. Dep. NTIS $5.00.

From conference on physical metallurgy of uranium alloys; Vail, Colorado, USA (12 Feb 1974).

Dilatometry, x-ray diffraction, hardness, and optical microscopy were used to characterize polycrystalline U–7.5% Nb–2.5% Zr. Upon quenching this alloy from the bcc phase at 800°C, a metastable modification corresponding to a slight tetragonal distortion of the bcc lattice along with a short-range atom displacement ordering was revealed by x-ray diffraction. Minor compositional variations, differing quenching rates, and low temperature aging cause important alterations in this metastable structural state. Slight depletion of the alloying elements increases the degree of tetragonality. Aging the quenched alloy initiates transformations to other anisotropic structural states. Altogether four transformation stages have been detected by dilatometry. At temperatures as low as 150°C, two stages (one beginning after a few minutes and the other after a few hours) produce a volume expansion of the alloy and a dramatic increase in hardness. The first stage is attributed to solute clustering. The second stage corresponds to an isothermal martensitic shear transformation, resulting in a second phase which may be described as a monoclinic modification of the α-uranium orthorhombic structure. Cellular or discontinuous precipitation is observed at temperatures between 500 and 620°C. Light rolling deformation of the quenched alloy causes an immediate crystal reorientation to take place in certain grains. Metallographic and x-ray evidence hints that this reorientation is accomplished by mechanical twinning at low strains. (22 figures, 37 references) (auth)

24713 (CONF-740205-9) REVIEW OF X-RAY DIFFRACTION STUDIES IN URANIUM ALLOYS. Yakel, H. L. (Oak Ridge National Lab., Tenn. (USA)). 1973. 53p. Dep. NTIS $4.75.

From conference on physical metallurgy of uranium alloys; Vail, Colorado, USA (12 Feb 1974).

Results of x-ray diffraction experiments investigating equilibrium structures of uranium-base substitutional alloys and routes of transitions between equilibrium structures are critically reviewed. Data on equilibrium alpha, beta, and gamma alloys are presented together with a résumé of work on the crystal structures of relevant stable intermetallic compounds. The second part of the review is principally concerned with x-ray diffraction studies of metastable phases: their structure and their mode of formation. Particular attention is given to the sequence of transitional phases found in gamma-quenched and aged uranium alloys, depending on aging time and temperature. The influence of external stresses imposed on the alloys before and during the transitions producing these phases is described in terms of the preferred orientations that may be observed by x-ray diffraction methods. Comparisons are drawn between the general structural behavior of uranium alloys and that of other alloy systems based on metals with allotropies similar to that of uranium. (8 figures, 4 tables, 142 references) (auth)

24714 (COO-3027-4) HIGH TEMPERATURE VAPOR PRESSURE AND THE CRITICAL POINT OF POTASSIUM. Jerez, W. R.; Bhise, V. S.; Das Gupta, S.; Bonilla, C. F. (Columbia Univ., New York (USA). Liquid Metals Research Lab.). 1973. 9p. (CONF-730851-6). Dep. NTIS $3.00.

From sixth symposium on thermophysical properties; Atlanta, Georgia, USA (6 Aug 1973).

The vapor pressure of potassium was experimentally determined from 2100°F up to its critical temperature. An empirical equation of the form $\ln P = A + B/T + C \ln T + DT^{1.5}$ was found to best fit the data. A critical pressure of 2378.2 ± 4.0 psia (161.79 ± 0.27 ata) was measured. The corresponding critical temperature, extrapolated from the pressure–temperature curve, is 4105.4 ± 5°R (2280.8 ± 3°K). The technique employed was the pressure tube method developed earlier in this laboratory and used for determining the vapor pressure of rubidium and cesium. This method measures the critical pressure directly, as well as the vapor pressure at lower temperatures. (4 tables, 6 figures, 26 references) (auth)

24715 (COO-3027-5) VAPOR PRESSURE AND CRITICAL POINT OF RUBIDIUM. Bhise, V. S.; Bonilla, C. F. (Columbia Univ., New York (USA). Liquid Metals Research Lab.). 1973. 7p. (CONF-730851-1). Dep. NTIS $3.00.

From sixth symposium on thermophysical properties; Atlanta, Georgia, USA (6 Aug 1973).

The vapor pressure of rubidium was experimentally determined from 1400°F up to its critical temperature. An empirical equation of the form $\ln P = A + B/T + C \ln T + DT^m$ fit the data well when $m = -2$. A critical pressure of 1942.9 ± 3.5 psia (132.2 ± 0.24 ata) was measured. The corresponding critical temperature, extrapolated from the pressure–temperature curve, agrees with 3790.7 ± 10°R (2106 ± 5°K) of Chung and Bonilla, which was adopted. The technique employed was the pressure tube method developed earlier in this laboratory and used for determining the vapor pressure of cesium. This method measures the critical pressure directly, as well as the vapor pressure at lower temperatures. (3 tables) (auth)

24716 (COO-3027-7) DETERMINATION OF INTERFACIAL TENSION AT HIGH TEMPERATURES. Surface Tension of Potassium and Interfacial Tension of Li/LiCl to 850°C. Chung, J. W.; Bonilla, C. F. (Columbia Univ., New York (USA). Liquid Metals Research Lab.). 1973. 7p. (CONF-730851-2). Dep. NTIS $3.00.

From sixth symposium on thermophysical properties; Atlanta, Georgia, USA (6 Aug 1973).

A modified maximum bubble pressure apparatus suitable for high-temperature determination of interfacial tension in a closed vessel was devised. It employs two capillaries of different diameters running downwards from the bottom of an upper pool to the same depth in a lower pool. A conical plug that can close off the larger tube permits utilization of either capillary at will. Simultaneous solution of Schroedinger's equation with the two maximum bubble pressure values yields the surface or interfacial tension conveniently without requiring observation of the submergence. The surface tension of potassium was measured under argon from 75 to 845°C, showing internal consistency and substantial agreement with some of the earlier studies. The interfacial tension of the system Li/LiCl was then measured by the same method from its melting point of 618 to 845°C. The results agree roughly with Antonoff's rule. (5 figures) (auth)

24717 (COO-3027-9) REVISION OF HIGH TEMPERATURE AND CRITICAL PROPERTIES OF CESIUM. Das Gupta, S.; Bhise, V.; Stuteville, D. W.; Chung, J. W.; Bonilla, C. F. (Columbia Univ., New York (USA). Liquid Metals Research Lab.). 1973. 10p. (CONF-730851-5). Dep. NTIS $3.00.

From sixth symposium on thermophysical properties; Atlanta, Georgia, USA (6 Aug 1973).

The high-temperature equilibrium vapor and liquid phase densities of cesium reported previously from a "tilting capsule" test were recalculated with the aid of generalized mathematical relations for the phase densities, instead of a rectilinear diameters line extrapolated from lower temperatures. The critical density and temperature found are 0.420 g/cc and 3686.0°R, respectively. In addition, the earlier high-temperature vapor pressure data and critical pressure of cesium by the "pressure tube" method were checked with the improved equipment now available, obtaining close reverification. The critical pressure was obtained as 1701.3 psia and the critical temperature by this independent method as 3699.1°R. Using the average critical temperature of 3692.1 ± 8°R, the critical compressibility factor of cesium is calculated as 0.2177. (6 tables, 4 figures) (auth)

24718 (COO-3027-10) HIGH TEMPERATURE SATURATED PHASE DENSITIES OF RUBIDIUM, AND THE CRITICAL PROPERTIES OF RUBIDIUM. Chung, J. W.; Bonilla, C. F. (Columbia Univ., New York (USA). Liquid Metals Research Lab.). 1973. 7p. (CONF-730851-3). Dep. NTIS $3.00.

From sixth symposium on thermophysical properties; Atlanta, Georgia, USA (6 Aug 1973).

A cylindrical capsule partially filled with rubidium metal hangs from transverse knife edges above the capsule at its center. The equilibrium tilt angle is measured at increasing temperatures until the capsule becomes horizontal at which rubidium inside the capsule has reached one saturated phase. The rest angle is solved simultaneously for the phase densities with the rest angle of another capsule containing a different rubidium mass, at the same temperature. The saturated phase densities are obtained up to the critical point. The critical temperature was 3331 ± 10°F and the critical density 0.347 ± 0.002 g/cc. (4 figures, 4 tables) (auth)

24719 (ORNL-tr-2747) HIGH-TEMPERATURE AUSTENITIC STEELS. von den Steinen, A. Translated by R. Gregg Mansfield from Dew Tech. Ber.; 9: No. 2, 134-145(1969). 25p. Dep. NTIS $3.25.

The creep-resistant austenitic steels developed from the 18/8 chromium–nickel steels are discussed. The requirements of the steel processing industry and the broadening of knowledge of creep behavior of metals and metallurgical interrelations increased the availability of materials within this group. Effect of different alloying elements on the creep–rupture properties of the lower alloyed austenitic steels is evaluated by means of a few alloying examples. Problems regarding stabilization and boron-containing steels are discussed. Finally, the creep-resistant austenitic steels alloyed with cobalt and titanium are mentioned and simultaneously compared with cobalt and nickel alloys in connection with their similar metallurgical behavior. (23 figures) (auth)

24720 (RDT-M-7-11-T(1-74)) NICKEL–MOLYBDENUM–CHROMIUM ALLOY ROD AND BAR (ASME SB-336 WITH ADDITIONAL REQUIREMENTS). (USAEC Division of Reactor Research and Development, Washington, D. C.). Jan 1974. 10p. RSO.

A standard prescribing requirements for Ni–Mo–Cr alloy rod and bar (ASME SB-336 with additional requirements for nuclear and associated applications is presented. This standard supersedes RDT-M-7-11T, dated January 1972. (JRD)

24721 (RFP-2061) CAUSES OF THE YIELD-POINT PHENOMENON IN COMMERCIAL BERYLLIUM PRODUCTS. Floyd, D. R. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 1 Feb 1974. Contract AT(29-1)-1106. 70p. Dep. NTIS $4.00.

The variables of iron content, texture, and grain size are studied as a function of solutionizing, aging, and strain-aging heat treatments. Results show that the yield point is caused by precipitate pinning. Furthermore, precipitation is enhanced by pre-strain, which can be introduced by elevated-temperature working, rapid cooling, or tensile elongation at room temperature. Aging is effective between 400 and 760°C, depending on the type of pre-strain, iron content, and texture. Cottrell-type solute pinning is not observed, and the Hahn model for yield drops in bcc metals best explains these results. Texture increases the likelihood of a yield point occurring. In the case of extruded-flat stock, texture causes a 3-fold increase in the amount of hardening accompanying the yield point when compared to hot-pressed block. Yield points appear on aging and strain-aging for orientations favoring either prism or basal flow. Fine grain size is a necessary condition for the occurrence of a yield point. A yield point can occur if: the average grain size is less than 10 microns, the microstructure is duplex and has a large number of grains less than 5 microns in size, a substructure exists with subgrains less than 5 microns in size. Grain-growth anneals can irreversibly eliminate a yield point. Differences in the frequency of appearance of yield points can be explained by the above factors, and a strong yield point can be developed in material supplied by Brush and KBI by appropriate treatment. The solid-solution hardening effect of iron on yield stress is linear with a slope of 2.3 psi per ppM in the range of iron from 640 to 5850 ppM. The grain-size effect, in the range from 8 microns to 45 microns, is seen to be linear for a Hall–Petch plot of yield stress versus inverse square root of grain size. The magnitude of the effect is 136 ksi $(\text{microns})^{1/2}$, which is the slope of the plot. (26 figures, 20 tables, 77 references) (DLC)

24722 (SLA-73-5542) AGING PHENOMENA IN DILUTE URANIUM ALLOYS. Eckelmeyer, K. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 66p. (CONF-740205-5). Dep. NTIS $5.50.

From conference on physical metallurgy of uranium alloys; Vail, Colorado, USA (12 Feb 1974).

The effects of aging on the structure and properties of three of the most extensively investigated dilute uranium alloys are discussed. On rapid quenching from the γ phase field these alloys undergo martensitic transformations to metastable, supersaturated, crystallographically distorted variants of the α phase. Aging of these metastable structures results in an initial period of increasing strength followed by a period of decreasing strength. The strengthening mechanism seems to be dependent on the nature of the as-quenched structure. In the acicular structures strengthening is due to a classical precipitation process. A different strengthening mechanism is active in the banded structures. This is hypothesized to be immobilization of twin boundaries, perhaps by atmospheres of interstitial atoms. Overaging results from the decomposition of the martensitic structures. The kinetics of the decomposition reactions are consistent with transformation theory. In some cases the martensite decomposes directly to the equilibrium phases whereas in other cases it transforms to an intermediate structure which in turn decomposes to the equilibrium phases. (auth)

24723 (SLA-74-6010) INFLUENCE OF THE GAMMA-PHASE COOLING RATE ON THE STRUCTURE OF URANIUM ALLOYS LOW IN TITANIUM. Fizzetti, C.; Franceschetti, G. Aug 1964. Translation of RT/MET-(64)3. 18p. Dep. NTIS $3.00.

The influence of the cooling rate from the γ phase on the structure of uranium alloys containing up to 1.5 wt % titanium was investigated. Low cooling rates yielded fine dispersion of U_2Ti in the α matrix, while at high cooling rates fine lamellae were obtained. Water quenching caused the complete retention of titanium in solid solution yielding martensitic structures. The grains of the α matrix were progressively refined by increasing the cooling rates. (auth)

24724 (UCLA-34-P-177-20) REACTOR STEEL STUDIES: THE ANALYSIS OF BURGERS VECTORS OF DISLOCATIONS IN COHERENT TWIN BOUNDARIES AND OTHER COINCIDENT SITE BOUNDARIES. Ardell, A. J.; McDonald, R. C. (California Univ., Los Angeles (USA). Dept. of Materials). Dec 1973. Contract AT(04-3)-34. 10p. Dep. NTIS $3.00.

The Burgers vectors of dislocations forming a network in a coherent twin boundary (CTB) in an austenitic stainless steel were determined by transmission electron microscopy. An extension of Barry and Mahajan's (1971) method of diffraction contrast analysis, wherein lattice planes that are continuous across the CTB are oriented for two-beam diffracting conditions, was used to show that the Burgers vectors are of the type $\pm\ a/6 <11\bar{2}>$. It is also shown that dislocation contrast can be very weak, or absent entirely, when only one of the two crystals on either side of the CTB is diffracting strongly and $g \cdot b \neq 0$. Finally, it is demonstrated that the extended method of diffraction contrast analysis can be applied to the determination of Burgers vectors of grain boundary dislocations in coincident-site boundaries other than CTBs. (auth)

24725 (UCRL-75395) PLASTIC FLOW AND STRENGTH OF URANIUM AND ITS ALLOYS. Sherby, O. D.; Bly, D. L.; Wood, D. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Jan 1974. 45p. (CONF-740205-6). Dep. NTIS $4.25.

From conference on physical metallurgy of uranium alloys; Vail, Colorado, USA (12 Feb 1974).

The mechanical behavior of uranium and its alloys is reviewed with special emphasis on plastic flow behavior of polycrystalline materials. The strength of uranium is influenced by crystal structure as well as by point, planar, and volume defects; with these factors in mind, texture hardening, strain hardening, solute hardening, grain and subgrain size hardening, and precipitation and particle hardening are discussed. Temperature and strain rate influence the various strengthening mechanisms in different ways, and these variables are considered whenever possible. Unusual mechanical effects result from the polymorphic nature of uranium and from anisotropic properties of alpha uranium such as thermal expansion and elastic stiffness; their importance on plastic flow is considered. Uranium and its alloys can be made superplastic, and the factors which contribute to such characteristics are discussed. (101 references) (auth)

24726 (WCAP-8237) HEAVY SECTION STEEL TECHNOLOGY PROGRAM TECHNICAL OR PROGRAMMATIC MANUSCRIPT No. 25. Variable Thickness Study of the Edge Cracked Bend Specimen. Wilson, W. K.; Begley, J. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Nov 1973. 46p. Dep. NTIS $4.50.

Variable thickness edge cracked bend specimens of A533-B steel were loaded, and displacements and strains were measured. The increase of displacement and strains with decreasing specimen thickness was particularly evident at higher load levels where the plastic zones were larger. The experimental data are compared with a plane strain and a plane stress elastic-plastic finite element solution. When slow crack growth does not occur, the experimental results are bounded by these two analytical solutions. The plane strain and plane stress solutions are studied in some detail. The crack surface displacement profiles are compared at various load levels. Calculations of the J integral at various load levels are made by means of the line integral definition. These calculated values of J are compared with two analytic approximations and experimentally determined values. (auth)

24727 MARTENSITIC TRANSFORMATIONS IN V_3Ga AND Nb_3Al. Viswanathan, R. (Univ. of California, San Diego, La Jolla). Contract AT(04-3)-34. Mater. Res. Bull.; 9: No. 3, 277-281(Mar 1974).

It is shown by low-temperature heat capacity measurements using ac technique that martensitic transformation in small samples of V_3Ga and Nb_3Al can be prevented by covering them nearly completely with copper plating. (auth)

24728 EDDY CURRENT MEASUREMENTS ON ULTRAPURE MOLYBDENUM AND RHENIUM. Riherd, M.C.; Schreiber, R. (Physics Department, Rice University, Houston, Texas 77001). J. Appl. Phys. 44: No. 11, 4908-4909 (Nov 1973).

An extension of the well-known eddy current method for measuring the resistivity ρ of low-resistivity specimens is described. The induced voltage in a pickup coil around a cylindrical sample is given, for a sudden field change, as $V(t)\ \varnothing \Sigma^{\infty}{}_{n=1} \exp[-\lambda_n{}^2\alpha\ (\rho)t]$. The usual procedure requires the measurement of V(t) for values of the time t such that only the first term in the sum need be considered. For low-resistivity metals, this method requires a long observation time (several seconds) and a low-noise high-gain amplifier. By including the first M terms in this expansion, the amplifier requirements and the observation time may be reduced. Resistivity data with an estimated error of less than 5% have been obtained for several ultrapure samples of Mo and Re at 4.2 K. (auth)

24729 NEUTRON DIFFRACTION STUDIES OF $ThNi_2Co_3$ AND $ThNi_3Co_2$ AT 5-297°K. Atoji, M; Atoji, I. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439); Do-Dinh, C.; Wallace, W. E. J. Appl. Phys. 44: No. 11, 5096-5099 (Nov 1973).

Neutron powder diffraction measurements of $ThNi_2Co_3$ and $ThNi_3Co_2$ show that, in the 5-297 °K range covering both the ordered and disordered magnetic phases, the Ni and Co atoms are distributed in (c); (1/3, 2/3, 0), (2/3, 1/3, 0) and (g); (1/2, 0, 1/2), (0, 1/2, 1/2), (1/2. 1/2, 1/2) of $D^1{}_{6h}$–P(6/m) mm with the following occupancy distribution: In (c), 1.10 Ni + 0.90 Co and 1.50 Ni + 0.50 Co; in (g), 0.90 Ni + 2.10 Co and 1.50 Ni + 1.50 Co, in $ThNi_2Co_3$ and $ThNi_3Co_2$, respectively. Hence, the numbers of the Co atoms in (c) and (g) in $ThNi_{5-5x}Co_{5x}$ $(0 \leq x \leq 1)$ are likely given by the interpolation formulas, $(5x^2 + 3x)/4$ and $(-5x^2 + 17x)/4$, respectively. This implies that the atomic concentration of the larger moment carrier, e.g., Co, is higher in (g) than in (c) at any given x for $0 < x < 1$. A reversed relation was postulated by van Diepen et al. for the isostructural ternaries $ThCo_{5-5x}Fe_{5x}$ and $ThNi_{5-5x}Fe_{5x}$; thus in these materials, Co and Ni preferentially occupy the 3g sites. The spontaneous ordered ferromagnetic moments of our systems are too small to give rise to the detectable magnetic intensity. Nevertheless, the diffraction effect due to the torque-induced preferential alignment of the powder particles in the external magnetic field verified that the moment direction is the c axis in both $ThNi_2Co_3$ and $ThNi_3Co_2$. The field-induced ferromagnetic moment above the Curie temperature aligns also in the c direction and is particularly large in $ThNi_2Co_3$. (auth)

24730 ISOTYPIC RELATION OF Zr_2Ni_7 AND Hf_2Ni_7. Dattagupta, J. K.; Schubert, K. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Z. Metallk.; 64: No. 11, 789-792 (Nov 1973). (In German).

The phase Hf_2Ni_7 is isotypic to Zr_2Ni_7. By strong deformation (mortaring without recrystallization) a hexagonal structure forms, which contains the stacking element of Zr_2Ni_7. In Zr_2Ni_7 and Hf_2Ni_7 an Al spatial correlation of the outer electrons of the T^4 component may be assumed. It generates the monoclinic symmetry by improving the commensurability. (GE)

24731 KNIGHT SHIFT OF ^{27}Al AND MAGNETIC SUSCEPTIBILITIES OF SOME INTERMETALLIC COMPOUNDS OF Al WITH Y AND Th. Kalantaryan, V. P.; Chechernikov, V. I. Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 7: No. 6, 474-476(1972). (In Russian).

Results of the measurements of Knight shift of ^{27}Al and magnetic susceptibilities in Al_2Y, AlY, Al_3Th, and AlTh intermetallic compounds are given. The various contributions to the Knight shift are estimated. (auth)

24732 OPTICAL REFLECTIVITY IN A15 COMPOUNDS. Benda, J. A. (Stanford Univ., CA); Geballe, T. H.; Wernick, J. H. Phys. Lett.; 46A: No. 6, 389-390(28 Jan 1974).

Optical reflectivity at normal incidence for a series of A15 compounds shows an absorption peak at 0.7 eV for V_3Si and V_3Ge and is attributed to a critical point in the joint density of states. No such peak was found in Ti_3Sb and V_3Pt. (auth)

24733 SINTERING MECHANISM OF SAMARIUM–COBALT ALLOYS. Gessinger, G. H.; de Lamotte, E. (Brown, Boveri and Co. Ltd., Baden, Switzerland). Z. Metallk.; 64: No. 11, 771-775(Nov 1973). (In German).

The sintering mechanism of samarium-cobalt alloys was investigated employing isothermal shrinkage measurements on pre-alloyed powders and powder mixtures in the concentration range from 23 to 42 wt. % Sm. The sintering temperatures were varied from 1,020 to 1,160°C. The three stoichiometric compounds Sm_2Co_7, $SmCo_5$ and Sm_2Co_{17} are characterized by comparatively slow sintering behavior, whereas hypo- and hyperstoichiometric $SmCo_5$ exhibits maxima of shrinking at the limits of its range of homogeneity. These are due to additional cobalt and samarium vacancies. Low-melting sintering additions do not increase the shrinkage, and only above their liquidus temperature is accelerated concentration equalization of the prealloys obtained. (GE)

24734 METALLOGRAFIYA TUGOPLAVKIKH REDKIKH I RADIOAKTIVNYKH METALLOV I SPLAVOV. (Metallography of Refractory, Scarce, and Radioactive Metals and Alloys). Mal'tsev, M. V. Moscow; Izdatel'stvo Metallurgiya (1971). 488p.

The structures, properties, and uses of refractory, rare earth, and radioactive metals and alloys are examined. The metals discussed are Li, Be, Ti, Zr, V, Nb, Ta, Cr, Mo, W, Re, rare earths, Th, U, and Pu. The structure of the most typical alloys is illustrated by macrophotographs and microphotographs. (tr-auth)

24735 ALLOYING BEHAVIOR OF ZIRCONIUM WITH OTHER TRANSITION METALS. Panda, S. C.; Bhan, S. (Banaras Hindu Univ., India). Z Metallk.; 64: No. 11, 793-799(Nov 1973).

The available data on the reactions of zirconium with other transition metals are reviewed and discussed in terms of electronic configuration of the valence shells, atomic size factor, and crystal structure criteria. New results on the zirconium–platinum system are presented and discussed. (GE)

24736 MATERIALY YADERNOI TEKHNIKI. (Nuclear Engineering Materials). Gerasimov, V. V.; Monakhov, A. S. Moscow; Atomizdat (1973). 336p.

The requirements placed on reactor materials are examined. The stability, compatibility, and radiation and corrosion resistance of construction and fuel materials are discussed. The physical, mechanical, and corrosion properties of reactor materials and the effect of operating conditions are examined. The characteristics of coolants are reported and the processes occurring in them under irradiation are examined. (tr-auth)

24737 MEKHANICHESKIE SVOISTVA METALLOV I SPLAVOV PRI OBRABOTKE DAVLENIEM. (Mechanical Properties of Metals and Alloys During Processing With Pressure). Tret'yakov, A. V.; Zyuzin, V. I. Moscow; Metallurgiya (1973). 224p.

General data on the changes of the mechanical properties of metals and alloys during processing with pressure are reported. The basic methods of mechanical testing in the hot and cold state are also given. The effect of different factors on the changes of the mechanical properties in the process of plastic deformation are analyzed. Data are reported on the ductility, hardness, and chemical composition of different metals, steels, and alloys. (tr-auth)

24738 KNIGHT SHIFT IN CADMIUM ALLOYS. Svechkarev, I.V.; Zhukov, V.V.; Zhuk, G.M. (Physicotechnical Institute of Low Temperatures, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Solid State 15: No. 4, 851-852 (Oct 1973).

The isotropic and anisotropic parts of the Knight–shift tensor for Cd^{113} nuclei in Cd–Mg alloys (up to 10% Mg) and Cd–Hg alloys (up to 12% Hg) are studied by induction spectroscopic measurements at 20.4, 77, and 293°K and similarity coefficients are determined. (AIP)

24739 SPIN–CORRELATION FEATURES IN RARE–EARTH METALS CLOSE TO THE NÉEL POINT. Boyarskii, L.A.; Starikov, M.A. (Institute of Inorganic Chemistry, Siberian Branch, Academy of Sciences of the USSR, Novosibirsk). Sov. Phys.–Solid State 15: No. 4, 858-859 (Oct 1973).

Comparison is made of measured spin susceptibilities of terbium, dysprosium and holmium with spin correlation parameters characteristic of collinear and helicoidal antiferromagnet models near the Néel point. (AIP)

24740 N$_{4,5}$ X-RAY EMISSION SPECTRA OF PRASEODYMIUM, NEODYMIUM, SAMARIUM, AND EUROPIUM. Gribovskii, S.A.; Fomichev, V.A.; Zimkina, T.M. (A. A. Zhdanov Leningrad State University). Sov. Phys.–Solid State 15: No. 4, 894-895 (Oct 1973).

Contributions to the observed N$_{4,5}$(4d) x–ray emission spectra of Pr, Nd, Sm and Eu from bremsstrahlen radiation and processes associated with the ionization of the 4d subshell are evaluated. (AIP)

24741 N$_{IV,V}$ x–RAY EMISSION SPECTRA OF GADOLINIUM, TERBIUM, DYSPROSIUM, AND HOLMIUM. Zimkina, T.M.; Fomichev, V.A.; Gribovskii, S.A. (A. A. Zhdanov Leningrad State University). Sov. Phys.–Solid State 15: No. 5, 1097-1098 (Nov 1973).

Plots of the N$_{IV,V}$ x–ray emission spectra of Gd, Tb, Dy and Ho are presented. Correlation with the corresponding x–ray absorption spectra, bremsstrahlung spectrum and ionization thresholds of 4d electrons are made and interpretations in terms of d shell and f shell electron transitions are discussed. (AIP)

24742 ADSORPTION OF SODIUM ON THE (112) FACE OF TUNGSTEN. Medvedev, V.K.; Smereka, T.P. (Institute of Physics Academy of Sciences of the Ukrainian SSR, Kiev). Sov. Phys.–Solid State 15: No. 5, 1106-1107 (Nov 1973).

Concentration and temperature dependences of the equilibrium work function, ϕ, for the Na–W(112) system are measured by the contact potential method. The dependence of the heat of adsorption on the concentration of adsorbed Na atoms is also derived from the data. (AIP)

24743 KINETIC PROPERTIES OF RHENIUM AT HIGH TEMPERATURES. Zinov'ev, V.E.; Masharov, S.I.; Gel'd, P.V. (S. M. Kirov Ural Polytechnic Institute, Sverdlovsk). Sov. Phys.–Solid State 15: No. 4, 869-870 (Oct 1973).

Measurements of the thermal conductivity and thermal diffusivity of single crystal rhenium between 850 and 3200°K are correlated with previously reported resistivity data on Re and its alloys with Mo and W. The nature of the Fermi surface and carrier scattering processes are discussed. (AIP)

24744 PRESSURE VESSEL HANDBOOK. Second Edition. Megyesy, E. F. Tulsa, OK; Pressure Vessel Handbook Publishing, Inc. (1973). 347p.

A reference book is presented containing formulas, technical data, and descriptions of construction methods associated with pressure vessels. The book is divided into four parts in which information is grouped on design and construction of pressure vessels, geometry and layout of pressure vessels, measures and weights, and miscellaneous items. (JRD)

24745 COERCIVE FORCE AND MICROSTRUCTURE IN A Zr PERMALLOY. Frohlich, C. R. Jr. (Western Electric Co., Inc.; Baltimore); Krauss, G.; Bestel, J. L. Met. Trans.; 5: No. 3, 733-738(Mar 1974).

An alloy containing 80.0% Ni, 12.65% Fe, 6.74% Mo, 0.36% Zr, and 0.25% Mn by weight was cast, homogenized, and successively cold rolled into thin strips with area reductions of 0, 50, 75, and 90%. Annealed samples were studied by optical and electron microscopy, electron diffraction, and magnetic testing to determine the effects of cold work and annealing on the microstructure and magnetic properties of the alloy. Cold work produced a high initial hardness together with high coercive force. Recrystallization of the cold worked structures occurred upon annealing at 600°C and above and caused significant and parallel decreases in hardness and coercive force. The activation energy for recrystallization was found to be 80.5 kcal/g mole (337.0 kJ/g mole) for the 50, 75, and 90% cold worked specimens. After annealing at 600°C, a small number of spherical Ni$_4$Mo particles were observed, but the particles produced little change in magnetic properties apparently because of their relatively coarse size and large spacing. Beginning at 700°C ribbon-shaped particles of a Ni$_5$Zr intermetallic compound also precipitated out of solid solution. Both the Ni$_4$Mo and Ni$_5$Zr precipitates were the result of a homogeneous continuous precipitation reaction within the grains. A peak in coercive force at 800°C is attributed to domain wall pinning associated with the fine distribution of rodlike Ni$_5$Zr particles. Cold working 90% and aging at 800°C was found to increase coercive force by almost 60% from the minimum produced by complete recrystallization. Annealing, however, decreased hysteresis and improved squareness. (auth)

24746 EFFECT OF SURFACE CONDITIONS ON NORMAL SPECTRAL EMITTANCE OF Ti AND Zr BETWEEN 1000 AND 1800K. Baria, D. N.; Bautista, R. G. (Ames Lab., Iowa). Met. Trans.; 5: No. 3, 555-560(Mar 1974).

The normal spectral emittance of Ti and Zr was obtained in the temperature range 1100 to 1800°K and wavelength 0.645 μ for electrochemically polished, mechanically polished, and 60 grit ground surfaces at a pressure below 10^{-6} mm Hg. The emittance at the melting point of both metals was obtained by extrapolation of an empirical equation fitted to the experimental data obtained for the electrochemically polished surface and was found to be in good agreement with reported values. The considerable grain growth on the surface affected the emittance. The emittance was found to increase with temperature up to 1300°K and then decrease with further increase in temperature. (auth)

24747 EFFECT OF PROCESSING ON PLASTIC ANISOTROPY OF Ti–6Al–4V. Amateau, M. F.; Dull, D. L.; Raymond, L. (Aerospace Corp., El Segundo, CA). Met. Trans.; 5: No. 3, 560-564(Mar 1974).

The plastic anisotropy of Ti–6Al–4V was examined after various thermomechanical treatments, including heat treating, rolling, and forging. Processing temperatures were varied from room temperature to 1340°K. The anisotropy, in terms of the strain ratio R, was measured by post-yield strain gages in the three principal directions, and results were correlated with the (0002) pole figures for each thermomechanical treatment. The plastic strain anisotropy, which was consistent with the basal pole orientation, was found to depend upon both the method and the temperature of mechanical working. The greatest R values occurred for the cold-rolled material where the basal poles rotate to within 15° from the sheet normal. In addition, R is not constant under uniaxial tension, but generally increases with the amount of plastic strain. The variation of R with uniaxial strain depends upon the forming temperature, and the largest changes occur in samples that were rolled at room temperatures. (auth)

24748 CREEP-FRACTURE CHARACTERISTICS OF WELD-REPAIRED CAST Ti−6Al−4V. Harrigan, W. C. Jr. (Aerospace Corp., El Segundo, CA). Met. Trans.; 5: No. 3, 565-572(Mar 1974).

Constant load creep tests were conducted with cast Ti−6Al−4V bars in air and vacuum at 315 and 650°C. Some of the bars were notched in their gage section and heliarc-welded to simulate a weld repair in a casting. Results indicate that the welding has little influence on the time to rupture of the bars. Fractographic analysis of the bars indicates minor differences in the welded and unwelded fracture surfaces. However, these differences do not affect the microstructural influence on the creep and fracture processes. The prior beta grain size and the alpha platelet size are shown to control the creep fracture of this alloy. These data show that weld repair of titanium castings for creep applications should be acceptable. (auth)

24749 STUDY OF GRAIN-BOUNDARY FRACTURE SURFACES IN DOPED TUNGSTEN−RHENIUM ALLOYS. Simpson, R. P. (Westinghouse Research and Development Center, Pittsburgh); Dooley, G. J. III; Haas, T. Q. Met. Trans.; 5: No. 3, 585-591 (Mar 1974).

The combination of Auger electron spectroscopy and scanning electron microscopy has identified the source of the unique interlocked elongated grains responsible for the high temperature sag resistance in doped tungsten and tungsten-rhenium alloys as due to bubbles which are formed by the volatilization of potassium during sintering. By pinning grain boundaries these bubbles raise the recrystallization temperature (from 1300 to 2100°C) and their distribution within the material controls the recrystallized grain morphology. There is a thin layer of potassium remaining on the bubble surfaces. The size and distribution of the bubbles is related to the amount of material deformation during processing. Increasing rhenium content does not affect the concentration or distribution of residual potassium. It has no noticeable effect on bubble size, distribution, or density. The presence of a thermal gradient during annealing does affect bubble density and recrystallization temperature. (auth)

24750 EFFECT OF Y_2O_3 VOLUME FRACTION AND PARTICLE SIZE ON ELEVATED-TEMPERATURE STRENGTH OF A DISPERSION-STRENGTHENED SUPERALLOY. Benjamin, J. S. (International Nickel Co., Inc., Sterling Forest, NY); Bomford, M. J. Met. Trans.; 5: No. 3, 615-621(Mar 1974).

The effect of yttrium oxide dispersoid volume fraction and particle size on the 1400°F and 1900°F rupture strength of a dispersion strengthened nickel-base superalloy, made by mechanical alloying, was investigated. Yttrium oxide contents ranged from 0 to 4.5% by volume, and average oxide particle sizes varied from about 150Å to 580Å. High volume fractions and small particle sizes gave low grain aspect ratios and poor 1900°F and 1400°F stress rupture properties following heat treatment. Rupture strengths at 1400°F were otherwise relatively unaffected by dispersoid parameters. At grain aspect ratios less than 6.0, 1900°F rupture strength was controlled by grain geometry while at higher values rupture strength was directly influenced by dispersoid parameters. (auth)

24751 EFFECT OF CARBIDE PHASES ON CRACK GROWTH OF 0.5% Mo−B STEELS UNDER IMPACT, CYCLIC, AND MONOTONICALLY INCREASING LOADING. Miller, G. A.; Stephenson, E. T. (Bethlehem Steel Corp., PA). Met. Trans.; 5: No. 3, 659-666(Mar 1974).

A study of the influence of carbide phases on the cracking resistance of as-quenched and of quenched and tempered 0.5% Mo-B steels was made using notched or notched and precracked specimens that were subjected to impact, cyclic, and monotonically increasing loading. The carbide influence on fracture, while limited in extent, was found to increase as load, loading rate, volume fraction, and particle size increase. The results for the as-quenched condition showed that the susceptibility of these steels to crack initiation under impact loading at temperatures below −100°F is greater when even a small amount of titanium carbide (less than 0.2 vol % of 1 to 5 μm particles) is present than when none is present. At room temperature, this same carbide concentration has no influence on impact properties, fatigue-crack initiation (in the presence of a notch), fatigue-crack growth rate, or the ductile fracture resistance under monotonically increasing loading at slow strain rate. In the case of the quenched and tempered materials, the alloy containing a large amount of $M_{23}C_6$ (2 vol % of 1 to 10 μm particles) exhibited behavior similar to that observed in the as-quenched materials containing titanium carbide. That is, the presence of $M_{23}C_6$ was associated with increased susceptibility to crack initiation for impact loading at low temterature. In addition, at room temperature this alloy had a reduced impact energy for crack propagation. For monotonically increasing loading at slow strain rate, this same carbide distribution had no influence on the net section stresses required to initiate stable or unstable crack growth. These stresses fall closely in line with, respectively, the yield stress and tensile strength of the material. The alloy containing $M_{23}C_6$ required less crack opening for a given crack extension—an effect most pronounced after maximum load. Attention is also directed to the use of Charpy test data to assess fracture resistance for modes of loading other than impact. (auth)

24752 KONDO EFFECT IN DILUTE Y–Ce ALLOYS. Borchi, E.; De Gennaro, S. (Istituto di Fisica dell'Università, Firenze 50125, Italy). Phys. Rev. B 9: No. 1, 209-214 (1 Jan 1974).

The influence of the hexagonal crystal field on the magnetic susceptibility and electrical resistivity of the Kondo system Y–Ce is studied in the framework of the s–f exchange model. The second–order–perturbation–theory magnetic susceptibility is computed exactly in the whole range of temperatures and the results of the calculation are compared with the available experimental data. From the theoretical behavior of the magnetic susceptibility the general conclusion that no "Kondo sidebands" are present in the susceptibility-vs-T curve is inferred. The third–order–perturbation–theory resistivity is computed exactly within the "usual" $f_k = 1/2$ approximation and a Kondo temperature of 1.4 K is estimated. (auth)

24753 SIZE–DEPENDENT OSCILLATORY MAGNETORESISTANCE IN CADMIUM. Hambourger, P.D.; Marcus, J.A. (Department of Physics, Northwestern University, Evanston, Illinois 60201). Phys. Rev. B 8: No. 12, 5567-5578 (15 Dec 1973).

Size–dependent oscillations in the magnetoresistance and Hall effect in cadmium have been studied using the field–modulation method. Nine sets of oscillations were observed for the first time and three sets discovered previously were observed with greater resolution over a larger range of field orientations. Most of the oscillations are assigned to orbits on the second–band "monster" and third–band "lens" sheets of the Fermi surface. The results indicate a slight departure of the lens from axial symmetry. Considerable second–harmonic content was observed on some of the oscillations. Disappearance of some monster oscillations but not the lens oscillations in magnetic fields greater than 8 kOe is attributed to the effect of magnetic breakdown of the energy gap between the first and second bands. Results are discussed in terms of the size–effect theory of Bloomfield and the Fermi–surface model of Stark and Falicov. (auth)

24754 ELECTRONIC STRUCTURE CHANGES WITH ROOM–TEMPERATURE AGING IN SUPERSATURATED ALLOYS OF CADMIUM IN ZINC. Park, J.K.; Gordon, W.L. (Department of Physics, Case Western Reserve University, Cleveland, Ohio 44106). J. Appl. Phys. 45: No. 2, 951-952 (Feb 1974).

The de Haas–van Alphen effect is used to determine the change of the Zn Fermi surface parameters in dilute Zn−Cd alloys containing up to 1.2 at.% Cd. Its application in observing the change of the matrix band structure during room–temperature aging is demonstrated. The presence of local concentration gradients and strain fields in the matrix during precipitation produce strong phase–smearing effects. (auth)

24755 DIFFUSION OF COMPONENTS OF NIOBIUM AND NICKEL ALLOYS IN CONTACT. Vasil'eva, E. V.; Prokoshkin, D. A.; Vasil'eva, A. I.; Kapralov, V. P.; Sigachev, A. P. (Moscow Technical Coll.). pp 53-56 of Protective Coatings on Metals. Vol. 5. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1973).

An Nb alloy (NT25A8; 25Ti, 8Al) and an Ni alloy (EI652; 27Cr, 2.5Al, 0.8Si . . .) were heated in contact to 1050°C. Of the elements in the Nb alloy, Ti diffuses rapidly into the Ni alloy, while Nb diffusion is small. Ni diffuses into the Nb alloy at a high rate, followed by Cr. A pure Nb/Ni couple was also heated to 1050°C, with similar results. (DLC)

24756 EFFECT OF B−Cu PLATING ON STRENGTH AND WEAR RESISTANCE OF MEDIUM-CARBON STEEL. Pokhmurskii, V. I.; Vagula, R. G.; Gribovskii, Ya. S.; Zamikhovskii, V. S. (Physicomechanical Inst., Lvov). pp 236-239 of Protective Coatings on Metals. Vol. 5. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1973).

Results show that adding 2 to 4% Cu powder to the boriding mixture increases the ductility of the diffusion layer and does not substantially reduce the surface hardness, friction properties, or fatigue strength. (DLC)

24757 EFFECT OF CHEMICAL COMPOSITION OF STEEL ON STRUCTURAL-STRESS CONDITION AND STRENGTH AFTER BORIDING. Protsik, V. G.; Brodyak, D. D.; Zamikhovskii, V. S.; Pokhmurskii, V. I.; Karpenko, G. V. (Physicomechanical Inst., Lvov). pp 253-256 of Protective Coatings on Metals. Vol. 5. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1973).

The effects of alloying additives (1 to 2% Mn, Si, Ni, or Cr) on the structure, strength, ductility, fatigue resistance, and corrosion fatigue resistance of borided medium-carbon steel 45 were investigated. Cr has the greatest effect on the strength, increasing it by 35 to 45%, while Ni had the least effect. Alloying increases the ultimate and yield strength and decreases the ductility and toughness. Boriding accentuates these changes. The fatigue limit is also increased, while the corrosion fatigue strength is decreased with alloying (increased with boriding). (DLC)

24758 WEAR RESISTANCE OF DIFFUSION BORIDE COATINGS IN VACUUM AND GASEOUS MEDIA. Golego, N. N.; Epik, A. P.; Derkach, V. D.; Labunets, V. F. (Inst. of Problems of Materials Science, Kiev). pp 257-260 of Protective Coatings on Metals. Vol. 5. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1973).

The effect of slip rate on friction and wear of borided steel 45 in vacuum and air was studied. At low slip rates (0.05 to 0.5 m/s), brittle fracture, galling, and substantial wear occurred. Increasing the slip rate to 1.5 or 2 m/s results in strength reduction in the substrate and increased temperature (700-800°C) of the rubbing surfaces. Oxidation affects the process in air, lowering the friction and wear. Sticking begins in vacuum at 0.5-0.6 m/s, but in air it does not begin until 3 m/s is reached. Boriding stabilizes the properties due to the relatively low wear and friction coefficient, particularly at high slip rates. (DLC)

24759 INVESTIGATION OF Ni–Cr–B COATINGS APPLIED BY PLASMA FLAME-SPRAYING. Veksler, Yu. G.; Kupriyanov, I. L.; Osinovskii, V. A. (Urals Polytechnical Inst., Sverdlovsk, USSR). pp 261-265 of Protective Coatings on Metals. Vol. 5. Samsonov, G. V. (ed.). New York; Plenum Publishing Corp. (1973).

A plasma-spraying and heat treatment technique was developed to deposit an Ni–Cr alloy of the Colmonoy type (15-17% Cr, 4% B, 4% Si, 0.6-0.7% C, 0.5% Mn, bal. Ni) on alloy EI-868 (VZH98). Optimum conditions were determined. The coating was found to have a high wear resistance, to be tightly adherent to VZH-98, and to be fairly heat resistant (850°C). (DLC)

24760 MAGNETIC PROPERTIES OF Ln_3In INTERMETALLIC COMPOUNDS. Hutchens, R. D. (Univ. of Pittsburgh); Wallace, W. E.; Nereson, N. J. Solid State Chem.; 9: No. 2, 152-154(Feb 1974).

Results of magnetic studies of Ln_3In phases (Ln = Pr, Nd, Gd, Dy, and Er) are presented. All materials exhibited Curie–Weiss behavior in the paramagnetic regions with effective moments approximating $g[J(J + 1)]^{1/2}$ for the tripositive ion. Positive Weiss constants were observed indicating predominance of ferromagnetic exchange. Pr_3In and Nd_3In order ferromagnetically at 62 and 114°K, respectively. However, the ordered moment is less than 10% of gJ. Dy_3In and Er_3In also seem to order ferromagnetically, but with low moments compared to gJ. Gd_3In exhibits metamagnetic behavior with a critical field of about 5 kOe. Neutron diffraction measurements on Nd_3In indicate that it is ferromagnetic and confirm the low Nd^{3+} moment. (auth)

24761 INVESTIGATION OF PROCESS OF DROP FORMATION DURING ELECTRON-BEAM MELTING OF METALS. Sundyrev, I. A.; Makunin, M. S. Fiz. Khim. Obrab. Mater.; No. 3, 53-57 (1973). (In Russian).

Experimental data are presented on the drop formation during melting of Mo and Ni. A theoretical examination is made of the results obtained. The dimensions of the metal drops formed on the electrode are connected with the physical properties of the metal. It is shown that the greatest effect on the radius of the drop are caused by the metal density, viscosity, and surface tension. The melting rate has little effect on the size of the drops. The form of the fused surface also has no effect. Experimental verification is given for the dependencies obtained. (tr-auth)

24762 PHYSICO-MECHANICAL PROPERTIES OF METALLOCERAMIC TUNGSTEN AFTER HYDROEXTRUSION. Mal'tsev, M. V.; Yakimova, A. M.; Beresnev, B. I.; Kurin, V. V.; Ezerskii, K. I. Fiz. Khim. Obrab. Mater.; No. 3, 100-104(1973). (In Russian).

The basic force and technological parameters of the hydroextrusion process of metalloceramic W were established. Hydroextrusion guarantees an increase of the strength and plasticity of the W and also the maintenance of these properties in the recrystallized state. Reduction of the transition temperature from the brittle to the viscous state is an important effect of hydroextrusion. Increase of the temperature of collective recrystallization of the metalloceramic W and the correlated increase of the temperature for the initiation of embrittlement during annealing are also caused by the hydroextrusion. (tr-auth)

24763 COMPACTION PROCESS IN LIQUID-PHASE SINTERING UNDER PRESSURE IN THE W–Cu SYSTEM. Naidich, Yu. V.; Lavrinenko, I. A.; Evdokimov, V. A. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 1, 34-39(Jan 1974). (In Russian).

The compaction process in liquid-phase sintering under pressure was studied in the system tungsten-copper. The effect of the applied pressure on the compaction is studied as dependent on the liquid phase content, sintering temperature, degree of solid phase wetting with liquid, and size of solid-phase particles. It is shown that a rise in the degree of the solid phase wetting by the liquid component favors a better penetration of liquid to the particles joints and increases shrinkage and compaction. Shrinkage and compaction in liquid-phase sintering under pressure exceeding the capillary pressure (for equiaxial particles of solid phase and the same volumetric content of the latter) in the systems without noticeable solubility of the component and with an unplastic solid-phase component are established to be either independent of or slightly dependent on the particle size of the solid phase. Definite plasticity of the solid phase and incomplete wetting of it with the liquid phase results in some decrease of shrinkage with a growth in particles size; this effect increases with the pressure rise. The results obtained give reasons to choose optimal conditions providing complete compaction of the sintered compositions. (auth)

24764 CALCULATION OF THERMAL EXPANSION OF REINFORCED METALS. Karpinos, D. M.; Tuchinskii, L. I.; Miroshnikova, T. K.; Vishnyakov, L. R. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 1, 80-84(Jan 1974). (In Russian).

A method is suggested for calculation of the thermal expansion coefficient (TEC) of composite materials reinforced unidirectionally by oriented fibres. The method takes into account an elastic-plastic behavior of the composite components. An experimental test of the dependences using the composite VZh-98–tungsten wire showed good agreement of the calculated and experimental values for TEC. Consideration of internal stresses in composite materials, the behavior of its components being elastic-plastic, is the basis explaining the character of the TEC temperature dependence. (auth)

24765 EFFECT OF ZIRCONIUM ON THE CONVERSIONS IN THE SYSTEM NIOBIUM–RUTHENIUM. Tatarkina, A. L.; Gryzunov, V. I.; Ronami, G. H.; Raevskaya, M. V.; Sokolova, I. G.; Sokolovskaya, E. M. Vestn. Mosk. Univ., Ser. II. Khim.; 14: No. 6, 673-678(1973). (In Russian).

The Nb–Ru system was investigated by the diffusion layer technique in the temperature range 1000 to 1700°C. The Nb–Ru–Zr alloys (10 at. % Zr) were studied by the physico-chemical methods at 1050 and 1600°C. (auth)

24766 MAGNETIC PROPERTIES OF INTERMETALLIC COMPOUNDS RuV, ZrV_2, HfV_2, $ZrRu_{0.5}$, AND $HfRu_{0.3}V_{1.7}$. Akhverdyan, M. M.; Chechernikova, O. I.; Raevskaya, M. V.; Sokolovskaya, E. M. Vestn. Mosk. Univ., Ser. II. Khim.; 14: No. 6, 736-737 (1973). (In Russian).

It was shown that the compounds investigated are the weak paramagnetics and their susceptibility decreases with the temperature increase. (auth)

24767 ZIRCONIC CERAMIC MASSES. Electrical Properties. Zaharescu, M.; Mavrodin-Tarabic, M.; Onaca, I.; Solacolu, I. Rev. Chim. (Bucharest); 24: No. 11, 888-895(Nov 1973). (In Rumanian).

Data and information are presented on ZrO_2 ceramics stabilized using CaO, Y_2O_3, or rare earth oxides. The electric properties of these oxides as electrolytes in reactors with fuel at 1000 to 1200°C are summarized. The purpose is to transform the chemical energy into electric energy. (auth)

24768 THERMAL CONDUCTIVITY OF LANTHANUM IN THE REGION OF ITS FIRST PHASE TRANSITION. Smirnov, I. A.; Khusnutdinova, V. Ya. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Solid State (Engl. Transl.); 15: No. 3, 639-640 (Sep 1973).

Translated from Fiz. Tverd. Tela; 15: No. 3, 923-924(Mar 1973).

The total thermal conductivity and the electric resistance of La were measured at 80 to 750°K. Both show kinks near 580°K, where the transition from the hexagonal to the fcc structure occurs. The lattice thermal resistance was calculated and plotted vs temperature; its behavior can be described assuming that phonons are scattered as a result of 3-phonon collisions and of collisions with conduction electrons as well as with paramagnetic Ce(<0.1%) and Nd(0.5%) impurity atoms. (DLC)

24769 ELECTROMIGRATION OF Ag AND Zn TRACERS IN Pr. Tessler, A.; Dariel, M. P. (Nuclear Research Center, Beer Sheva, Israel). J. Less-Common Metals; 35: 235-243(1974).

The steady-state method was used in order to study the electromigration of silver and zinc tracers in praseodymium. The silver tracers migrate toward the cathode with an effective charge $Z^* \sim 1$ while Z^* of the zinc tracers is close to zero. These results suggest that the diffusion of these solutes does not take place by a purely interstitial mechanism. (21 references) (auth)

24770 OBSERVATION OF DEFECT AND MAGNETIC DOMAIN STRUCTURES IN COBALT–RARE-EARTH INTERMETALLIC COMPOUNDS BY ELECTRON MICROSCOPY. Riley, A. (Univ. of Salford, Eng.). J. Less-Common Metals; 35: 305-313(1974).

As models suggested to explain the coercivity of RCo_5 particles have included nucleation and pinning of domains at crystal defects, transmission electron microscopy was used to observe defects and magnetic domain walls in foils of $SmCo_5$ and other RCo_5 compounds. The general microstructure of the cast compounds have been described and some pinning events were observed. The nonsmoothness of domain wall movement observed in thicker foils during magnetization gives some support for general pinning processes occurring but stronger local pinning is also in evidence. (4 fig) (auth)

24771 RADIOAUTOGRAPHIC INVESTIGATION OF BORON DISTRIBUTION BY MEANS OF SOLID TRACK DETECTORS. Doege, H. G.; Finke, P. (Zentralinstitut fuer Festkoerperphysik und Werkstofforschung, Dresden). Isotopenpraxis; 9: No. 6, 200-202(Jun 1973). (In German).

Experimental investigation of boron distribution with cellulose acetate foil as a solid track detector is reported with particular attention being paid to the working conditions and the evaluation. The results of these investigations are compared with those from a metallographic examination of structure. (auth)

24772 PURITY DEPENDENCE OF QUENCHED-IN RESISTIVITY IN Mo AND W. Yoshioka, K. (Tohoku Univ., Japan); Suezawa, M.; Kimura, H. Scr. Met.; 8: No. 2, 111-114(Feb 1974).

Results of measurements are presented and discussed on quenched-in resistivities in Mo and W as related to the reciprocal of the quenching temperature normalized with the melting points of these metals. Discussions are also included on the quenched-in resistivities in Mo containing various amounts and kinds of impurities. It is noted that further investigations are necessary to clarify the relations between purity dependence in W and solute interstitial impurities. (JRD)

24773 PRIMARY DIRECTIONS OF GROWING REFRACTORY METAL CRYSTALS IN CONDITIONS OF ELECTRON-BEAM ZONE MELTING. Pikunov, M. V.; Shiskov, V. V.; Strigina, N. I.; Zhidovinova, S. V. Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 5, 110-113(1973). (In Russian).

The preferred growth direction of W and Nb under electron-beam zone melting conditions studied at different rates of motion of the zone are described. The results obtained confirm the assumption that at low growth rates the crystals are developed in a direction close to $\langle 110\rangle$, with increase of the rate around $\langle 100\rangle$. (JSR)

24774 PHASE FORMATION IN Al–Mo ALLOYS AT NON-EQUILIBRIUM CRYSTALLIZATION. Lyukevich, R. B.; Varich, A. N. (Dnepropetrovsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 5, 131-134(1973). (In Russian).

During quenching of Al–Mo alloys from the liquid state, supersaturation of the solid solution with Mo continuously increases as a function of the superheating. At high cooling rates from the liquid state the equilibrium phase $Al_{12}Mo$ is not formed. During quenching of the alloy from the two-phase region the compound Al_5Mo is formed and the formation of the compound $Al_{12}Mo$ is added. The quantity of the finely dispersed Al_4Mo phase decreases with increase of the quenching temperature and only the solid solution is observed at temperatures above 1100°C. (tr-auth)

24775 INFLUENCE OF LOW CONCENTRATIONS OF TITANIUM AND ZIRCONIUM ON NIOBIUM RECRYSTALLIZATION. Prokoshkin, D. A.; Vasil'eva, E. V.; Markov, S. A. (Moscow Higher Technical School). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 5, 140-144(1973). (In Russian).

The effect of small quantities of Ti and Zr on the recrystallization of Nb is studied on alloys with 1 to 6 at.% Ti or 0.5 to 5 at.% Zr. The experimental results show that alloying with Ti or Zr results in an increase of the temperature for the beginning and end of recrystallization. This is particularly evident for alloys with 0.5 at.% Zr or 1 at.% Ti. The mechanism for this influence on the recrystallization temperature is discussed. (JSR)

24776 ELECTRON-OPTICAL STUDY OF β-HYDRIDE AND HYDROGEN EMBRITTLEMENT OF VANADIUM. Takano, S.; Suzuki, T. (Tokyo Univ.). Acta Met.; 22: No. 3, 265-274(Mar 1974).

The structure of β-hydride precipitated in the bcc matrix of hydrogen charged vanadium has been studied by electron diffraction in conjunction with electronmicroscopy. The β-hydride precipitate particles are coherent with the matrix, being composed of microscopic domains. Each domain is an elementary hydride of the monoclinic structure with the axial ratio of about 1.10 at room temperature and one of the angles between three axes is equal to 91°. It is shown that hydrogen atoms are arranged in the interstitial $\{101\}$ planes with a period twice that of the vanadium cell. Electronmicroscopic studies have revealed that the stability of β-hydride particles is very small and apt to be influenced by external stress. In fact, a crack is initiated in a β-hydride particle and grows through new β-hydride particles precipitated successively at its growth front by the aid of the stress concentration in the range of temperature from about 100°K to a fairly high temperature above the hydride formation temperature that is defined in the case where no external stress is applied. (auth)

24777 STRESS-ASSISTED DIFFUSION TO DISLOCATIONS. II. Higher-Order Decay Constants in an Eigenfunction Expansion Description. Meisel, L. V.; Scanlon, R. D.; Cox, J. F. (Watervliet Arsenal, NY). J. Phys. Chem. Solids; 34: No. 12, 2209-2213(Dec 1973).

Stress-assisted diffusion to dislocations is considered in terms of an expansion in decaying exponentials. The dependence of higher order decay constants on dislocation density, Cottrell attraction parameter, and temperature is determined by a numerical treatment of the boundary value problem. The results are discussed as they apply to sets of published decay constants for stress relaxation in iron and for dislocation pinning in irradiated and/or cold-worked NaCl, KCl, and Pb. (auth)

24778 PROPERTIES OF WELDED JOINTS OF ALLOYS IN THE SYSTEM Ti–V, Ti–V–Al, AND Ti–Zr–Al WITH HIGH OXYGEN CONTENT. Gurevich, S. M.; Blashchuk, V. E.; Onoprienko, L. M. (Electric Welding Inst., Kiev). Metalloved. Term. Obrab. Metal.; No. 10, 6-8(1973). (In Russian).

A study was made of the mechanical and corrosion properties of welded joints of the alloys AK1 (Ti + 2.5% V), AK2 (Ti + 2.5% V + 3% Al) and AK3 (Ti + 5% Zr + 2% Al), containing 0.25 to 0.35% O. Rolled specimens 6 mm thick were studied. The plates were welded by an automatic single-pass argon-arc welding machine using infusable tungsten electrodes. It is shown that the strength, ductility, and corrosion resistance of the welded joints are quite close to the figures for the base metal. (JPRS)

24779 PLUTONIUM-DOKUMENTATION. Transplutonium-Elemente. Referate-Zeitschrift. Dezember 1973. Band 7, Heft 12. 187 Referate (Register-Nr. 4759–5143); 91 Referate (Register-Nr. 951T–1041T)). (Plutonium Documentation. Transplutonium Elements. Abstract Journal. December 1973. Vol. 7, No. 12. 187 Abstracts (Register No. 4759–5143); 91 Abstracts (Register No. 951T–1041T))). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung m.b.H. (Dec 1973). 129p. (In German and English).

24780 VAPOR PRESSURE OF α-SAMARIUM AND α-YTTERBIUM. Desideri, A.; Piacente, V.; Nobili, S. (Univ., Rome). J. Chem. Eng. Data; 18: No. 2, 140-141(Apr 1973).

The torsion-effusion method was used to determine the vapor pressure of α-samarium and α-ytterbium in the temperature range 1043 to 1179K and 775 to 907K, respectively. The proposed heat of sublimation at 298K, obtained as an estimated average between second-and third-law values, was 49.56 ± 0.50 and 37.20 ± 0.40 kcal/mol for α-samarium and α-ytterbium, respectively. (auth)

24781 CONSTITUTION OF THE CERIUM–LANTHANUM–COBALT SYSTEM. Khan, Y.; Feldmann, D. (Univ., Bochum, Ger.). Z. Metallk.; 64: No. 12, 853-854(Dec 1973). (In German).

The constitution of the Ce–La–Co system in the region of $Ce_{0.6}La_{0.4}Co_5$ forms the basis of the commercially interesting hard magnetic alloys on the basis of cerium–Mischmetal–Co_5. Therefore, alloys between $(Ce_{1-x}La_x)_2Co_7$ and $(Ce_{1-x}La_x)Co_{13}$ were investigated structurally and metallographically. $(Ce_{1-x}La_x)_2Co_7$ and $(Ce_{1-x}La_x)Co_5$ solid solutions were found to exist for all values of n, with continuously varying lattice parameters. The extent of the $(Ce_{1-x}La_x)_5Co_{19}$, $(Ce_{1-x}La_x)_2Co_{17}$ and $(Ce_{1-x}La_x)Co_{13}$ solid solutions is different. Details of the different phases are given. (GE)

24782 VANADIUM ALLOY. Lensi, P.; Piatti, G. (to Commission of the European Communities). Dutch Patent 7,200,886. 21 Jan 1972. (In Dutch).

A new vanadium alloy containing 0.25 to 2.0% by weight of Si and 11 to 15% by weight of Nb has a tensile strength of 50 to 60 kg/mm^2 at a temperature of 800°C. (auth)

24783 BERYLLIUM: PHYSICO-CHEMICAL PROPERTIES OF ITS COMPOUNDS AND ALLOYS. At. Energy Rev.; No. 4, Special Issue, 1-175(Nov 1973).

Information and data are presented on thermodynamic properties, densities, crystallographic structures, equilibrium diagrams, and diffusion rates in condensed states of beryllium compounds and alloys. (JRD)

24784 X-RAY EMISSION SPECTRA OF NIOBIUM IN ITS GERMANIDES. Nemoshkalenko, V. V.; Nikolaev, L. I.; Krivitskii, V. P.; Mindlina, M. A. (Inst. of Metal Physics, Kiev). Metallofizika; No. 47, 57-60(1973). (In Russian).

A study was made of the L- and M-emission spectra of niobium from a series of intermetallic compounds of niobium and germanium: Nb_3Ge (16 at. % Ge), Nb−23 at. % Ge, Nb_5Ge_3 (30.2 at. % Ge) and $NbGe_2$ (63.7 at. % Ge). The M-spectra were followed on an x-ray spectrometer with a bent spherical diffraction grating, and the L-spectra on a spectrograph with a quartz crystal analyzer. Parameters of the $L_{\bar{\beta}_2}$, L_{γ_1} and $M_{IV,V}O_{II,III}$-emission bands were studied. On the basis of these results, conclusions were drawn with regard to the electron structure of these compounds and with regard to the character of the interatomic interaction in these compounds. (SJR)

24785 CHANGE IN STRUCTURE OF SINGLE-CRYSTAL MOLYBDENUM DURING CREEP. Demchenko, L. V.; Kononenko, V. A. (Inst. of Metal Physics, Kiev). Metallofizika; No. 47, 61-66(1973). (In Russian).

Single-crystal molybdenum samples of different orientation were investigated in the process of creep at $T = 1360°C$ and $\sigma = 1$ kg/mm^2. The structure was followed by x ray and metallographic methods. Optical microscopy was used to observe the appearance of deformation tracks on the polished surface of the crystals. From quantitative calculations of the average angle of disorientation of the substructure in the same part of the crystal it was established that the disorientation changes only slightly at early stages of creep, but increases strongly at the beginning of the second stage. It is shown that the increase in disorientation with increasing deformation depends on the spatial orientation of the x ray reflection planes. It is established that the behavior of the single crystals at the first stage of creep depends on the orientation of the applied load with respect to the possible planes of glide. (SJR).

24786 STUDY OF THE ELECTRON STRUCTURE OF DEFECTS IN SOLID SOLUTIONS OF TUNGSTEN AND RHENIUM. Budagovskii, S. S.; Bykov, V. N.; Gavrilyuk, M. I.; Dekhtyar, I. Ya.; Mikhalenkov, V. S.; Pod'yachev, V. N. (Inst. of Metal Physics, Kiev). Metallofizika; No. 47, 66-69(1973). (In Russian).

The angular distribution of annihilation photons (ADAP) follows a gaussian distribution for annealed alloys, and a parabolic distribution for deformed alloys. An increase in the parabolic contribution to ADAP is associated with positron capture by dislocations with subsequent annihilation in the dislocation nuclei. It was found that in the deformed state, anomalies in the parabolic component of ADAP and in hardness were observed at ~2% Re in tungsten. Additional Mossbauer lines could also be observed at 2% Re concentration in tungsten alloys. (SJR)

24787 PHASE EQUILIBRIA IN THE TERNARY SYSTEM OF VANADIUM−MOLYBDENUM−ZIRCONIUM. Tret'yachenko, L. A.; Gusarenko, L. A.; Eremenko, V. N. (Inst. of Problems in Materials Science, Kiev). Metallofizika; No. 47, 108-112(1973). (In Russian).

Cast and annealed alloys of the V−Mo−Zr system were investigated by the methods of metallography and x rays, and by determining the temperatures of initial melting. It was found that $ZrMo_2$ and ZrV_2 form a continuous series of solid solutions with a cubic structure of the type $MgCu_2$ (λ_2). The λ_2 phase is formed by a peritectic reaction from a molten liquid and a metallic solid solution based on V + Mo (α). The temperature of the three-phase equilibrium $L + \alpha \rightleftharpoons \lambda_2$ decreases from 1900°C on the molybdenum-zirconium side to 1290°C on the vanadium-zirconium side. In the region $Zr-ZrMo_2-ZrV_2$ crystallization begins with separation of α, λ_2 or β, depending on the composition, and is completed by solidification of excess liquid in the form of a mixture of $\beta + \lambda_2$. The temperature of the three-phase equilibrium $L \rightleftharpoons \beta + \lambda_2$ decreases from 1560°C on the zirconium−molybdenum side to 1230°C on the zirconium−vanadium side. Below the solidus λ_2 is in equilibrium with α (in the region $Mo-V-ZrV_2-ZrMo_2$) or with a solid solution on a base of $\beta-Zr$ (in the region $Zr-ZrMo_2-ZrV_2$). The solubility of zirconium in V + Mo and of V + Mo in β-zirconium decreases with increasing ratio of V:Mo and with decreasing temperature. (tr-auth)

24788 INFLUENCE OF ALUMINUM, POTASSIUM, AND SILICON ON PROPERTIES OF TUNGSTEN. Kostkowski, A. Rudy Metale Niezelaz.; 18: No. 8, 394-398(Aug 1973). (In Polish).

Based on an analysis of recently published information on tungsten, the influence of small quantities of K, Al, and Si on properties of tungsten wire was investigated. The mechanism of gas bubble formation and its role in strengthening the metal is discussed. (auth)

24789 EFFECT OF HYDROGEN ON YOUNG'S MODULUS OF Ta, Nb, AND V. Wriedt, H. A.; Oriani, R. A. (U. S. Steel Research Lab., Monroeville, PA). Scr. Met.; 8: No. 3, 203-208 (Mar 1974).

Results of experiments are presented showing that dissolved H increases the Young's modulus of Ta, Nb, and V. It is concluded that the magnitude of the Young's modulus (E) is related to the magnitude of the force constant for the vibration of atoms about their normal equilibrium positions in the lattice, and to the value of the initial slope of the cohesive force as a function of elastic strain. Therefore, an increase of E with dissolved hydrogen in the low-concentration region indicates that the initial slope of the curve of cohesive force vs. strain for these three bcc metals is larger with a given, small amount of dissolved hydrogen than without. Very little can be learned from these measurements relative to how the maximum of the cohesive force-strain curve is affected by dissolved hydrogen at constant chemical potential, the property relevant to the decohesion theory of hydrogen embrittlement. (auth)

24790 STRAIN-RATE SENSITIVITY OF FLOW STRESS IN DRAWN POWDER-METALLURGICAL TUNGSTEN WIRES. Nagy, A. T.; Ignacz, P. N.; Varga, L.; Gaal, I. (Research Inst. for Tech. Physics, Budapest). Scr. Met.; 8: No. 3, 209-211(Mar 1974).

Stress relaxation data on the cold-drawn wires are presented graphically showing a semilogarithmic relationship. The linear function of the logarithm of the strain rate in these wires at a given temperature is also represented graphically showing that the amount of the thermal flow stress component is independent of the total magnitude of the flow stress. Data are also included on strain rate dependence of stress relaxation in wires treated with various different dopants. (JRD)

24791 OBSERVATIONS ON DEFORMATION-INDUCED β INTERNAL FRICTION PEAK IN THE BCC METALS. DiCarlo, J. A. (Lewis Research Center, Cleveland). Scr. Met.; 8: No. 3, 281-288(Mar 1974).

Internal friction data are presented on W indicating that the mechanism underlying the β relaxation peak does not incorporate the relaxation parameters generally associated with simple dislocation processes. These data are discussed along with similar data on other bcc metals. It is noted that apparent similarities between the β peaks and those peaks found near martensitic transformations suggest that the β mechanism is the relaxation of twin boundary interfaces, controlled in some manner by the thermally-activated motion of deformation-induced point defects. (JRD)

24792 FIELD-ION MICROSCOPY OBSERVATIONS OF ORDERED GRAIN-BOUNDARY STRUCTURES IN TUNGSTEN. Ishida, Y.; Smith, D. A. (Oxford Univ.). Scr. Met.; 8: No. 3, 293-298(Mar 1974).

It is noted that the structure of coincidence related ordered boundaries and that of associated defects such as grain boundary dislocations and boundary steps are fairly well understood. However, other possible types of ordered or partially ordered structures in grain boundaries exist. Field-ion microscopic observations of such ordered structures in W are reported. Examples are included to show that although a large proportion of grain boundaries are coincidence related, partially or nearly ordered boundaries also exist. The results presented add to the evidence that both periodicity and near periodicity may play a part in determining grain boundary structures. (JRD)

24793 DISLOCATION DENSITY AND INTERNAL STRESS IN INVERSE TRANSIENT CREEP OF Fe−3.5 AT. % Mo ALLOYS.

Maeda, M.; Oikawa, H.; Karashima, S. (Tohoku Univ., Sendai). Scr. Met.; 8: No. 3, 183-188(Mar 1974).

During inverse transient stage in high-temperature creep of Fe−3.5 Mo alloy, the total dislocation density increases with increasing creep strain, whereas the internal stress determined by the dip test decreases. The (total) dislocation density seems to be one of the most significant factors in determining the transient creep rate. On the contrary, the internal stress seems to play a minor role. Other factors should be examined to give a quantitative explanation of the creep rate during the inverse transient stage observed in a fully-annealed state. (auth)

24794 LOW-TEMPERATURE HEAT-CAPACITY STUDIES ON $DyFe_3$, $DyCo_3$, $DyNi_3$, AND $LaNi_3$. Narasimhan, K. S. V. L.; Butera, R. A.; Craig, R. S.; Wallace, W. E. (Univ. of Pittsburgh). J. Solid State Chem.; 9: No. 3, 267-272(Mar 1974).

Heat capacity measurements were made over the temperature range 1.4 to 15°K. Two anomalies, observed at 1.8 and 9.3°K, are ascribed to the presence of an oxide and a hydride. Another anomaly exists at 3.2°K, which may be due to hydroxide. The observed electronic specific heat coefficients are interpreted in terms of the band structure of these materials. (5 fig) (auth)

24795 EFFECT OF OXYGEN ON MAGNETIZATION REVERSAL OF RARE-EARTH-Co_5 PARTICLES. Searle, C. W. (Air Force Materials Lab., Wright Patterson AFB, OH). Appl. Phys. Lett.; 24: No. 1, 30-32(1 Jan 1974).

The nucleation field for rare-earth-Co_5 particles is shown to be directly related to variations in the domain wall energy associated with an oxide layer at the particle's surface. A physical model based on the experimental results for $Nd_{1-x}Sm_xCo_5$ single crystals can quantitatively describe the magnetization reversal. (auth)

Radiation Effects

Refer also to abstracts 25950, 26011, 26084, 26095, 26136, and 26138.

24796 (AERE-R-7454) EFFECT OF RADIATION ON THE AQUEOUS CORROSION OF ZIRCALOY: A SURVEY OF WORLD EXPERIENCE. Asher, R. C. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Nov 1973. 100p. Dep. NTIS (U. S. Sales Only) $7.00. UK £ 2.00.

World experience on the effect of reactor radiation on the aqueous corrosion of Zircaloy 2 is summarized in the form of standard data sheets. The survey has been restricted to observations on unfueled specimens and on pressure tubes; it includes work from BNWL (USA), AECL (Canada), IFA (Norway) CISE (Italy), RCN (Holland), AB Atomenergi (Sweden), AERE (UK), RML (UK) and AAEC (Australia). (auth)

24797 (BNL-18574) RADIATION DAMAGE IN REACTORS. Vineyard, G. H. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 20p. (CONF-740201-1). Dep. NTIS $3.00.

From topical conference on energy; Chicago, Illinois, USA (4 Feb 1974).

Fuel, cladding, structural materials, moderators, coolants, pressure vessels, and other components of nuclear reactors are bombarded by fast and thermal neutrons (with fluxes up to and above 10^{15} cm^{-2} sec^{-1}) at elevated temperatures. Fuel elements are also exposed to fission fragments; all components are exposed to high fluxes of gamma rays. As a result the physical properties of materials are modified, usually in undesirable ways. Brittleness, altered creep, and swelling which leads to complex deformations and induced stress are common problems. A broad understanding of these effects in terms of displaced atoms, point defects, dislocations, disordered regions, voids, and transmutation-induced impurities has been developed. Much empirical information is available, and means for lessening certain effects have been found. Knowledge of the details of atomic mechanisms, particularly their quantitative aspects, in the broad range of materials of interest is still inadequate, and the body of empirical data, particularly at the higher levels of exposure, needs to be extended. Bombardment of thin specimens with charged particles from accelerators has been a useful tool for simulating high neutron exposure, but the degree to which the simulation is adequate needs further investigation. (auth)

24798 (CEA-CONF-2489) IRRADIATION EFFECTS ON HASIGUTI PEAKS IN GOLD AND ALUMINUM. Mercier, O.; Benoit, W.; Moser, P.; Fantozzi, G.; Perez, J.; Gobin, P. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). [nd]. 9p. (CONF-730844-4). Dep. NTIS (U.S. Sales Only) $3.00.

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973).

Deformed and annealed Au and Al were irradiated by either 2-MeV electrons at 20°K or neutrons at 77°K. The Hasiguti (internal friction) peaks appear after plastic deformation at low temperature and after irradiation, providing a dislocation network is already present. The peaks are explained by the point defects pinning the dislocations. A model of the recovery (stages II and III) is proposed. (DLC)

24799 (CEA-CONF-2490) SELF INTERSTITIAL RELAXATION IN HEAVILY IRRADIATED BCC, HCP, AND FCC METALS. Moser, P.; Verdone, J.; Chambron, W.; Hivert, V.; Pichon, R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Recherche Fondamentale). [nd]. 11p. (CONF-730844-5). Dep. NTIS (U.S. Sales Only) $3.00.

From conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, F. R. Germany (27 Aug 1973).

Internal friction peaks obtained for five metals (Mo, Fe, Zr, Ti, Ni) are interpreted in terms of Nowick's theories. The split interstitial in Ni does not give rise to any peak, but if an impurity is in the neighborhood, one peak appears. For the other metals, examples of "frozen free split" are given. (10 figures, 30 references) (DLC)

24800 (CEA-CONF-2535) DIFFUSION ACCELERATED BY IRRADIATION IN SILICON. Study of the Kinetics and the Distribution of Impurities. Baruch, P.; Bouvatier, M.; Picard, C.; Epelboin, Y.; Monnier, J.; Netange, B. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 3 Aug 1973. 18p. (In French). (CONF-730574-11). Dep. NTIS (U. S. Sales Only) $3.00.

From Congress on the centenary of the French Physics Society; Vittel, France (28 May 1973).

The simple model of diffusion by lacuna was analyzed by calculating the profiles of the distribution of impurities. Experimental studies of the effects of high energy and low energy irradiation on the kinetics and distribution of P and B impurities in Si were reported. A comparison of the experimental and theoretical results showed that the simple model of lacuna diffusion can not explain the phenomena observed in the irradiated Si. The concentration profiles and their evolution as a function of the flux follow at low energy only qualitatively the predictions of the simple model and are incompatible with it at high energies. (JSR)

24801 (CONF-721115-7) STRESS-INDUCED DEFORMATION OF METALS DURING FAST-NEUTRON IRRADIATION. Wolfer, W. G.; Boltax, A. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1972. Contract AT(11-1)-3045. 26p. Dep. NTIS $3.50.

From European conference on irradiation embrittlement and creep in fuel cladding and core components; London, UK (9 Nov 1972).

Theoretical models for the deformation of metals subjected simultaneously to external loads and fast-neutron irradiation are discussed. The following models have been analyzed in detail: dislocation climb; climb controlled glide; and nucleation, growth, and unfaulting of dislocation loops. It is shown that the strains produced only by the climb of dislocations are equal to the isotropic swelling strains plus the thermal creep strains due to climb of dislocations. No irradiation-induced creep results from the climb of dislocations or growth of loops. The climb controlled glide of dislocations is a viable irradiation creep mechanism for low fluences at all temperatures or for all fluences at high temperatures. At low temperatures the hardening occurs by the elastic interaction of loops and dislocations. It is shown that the climb controlled glide of dislocations through the loop structure can explain the transient irradiation creep behavior. Steady-state creep, however, at low temperatures is explained by the stress-affected nucleation of dislocation loops. Comparison of the theoretical prediction with the experimental results suggests that stress not only influences the orientation of the loop nuclei but also enhances the interstitial loop nucleation and reduces the vacancy loop nucleation. In addition, various mechanisms are discussed briefly for the effects of stress on the irradiation-induced swelling of metals. Since irradiation creep and swelling both occur by partial segregation of vacancies and interstitials it was concluded that the two phenomena are closely related. (auth)

24802 (CONF-740104-7) RADIATION BLISTERING OF STRUCTURAL MATERIALS FOR FUSION DEVICES AND REACTORS. Das, S. K.; Kaminsky, M. (Argonne National Lab., Ill. (USA)). 1974. 13p. Dep. NTIS $3.00.

From surface effects in controlled thermonuclear fusion devices and reactors meeting; Argonne, Illinois, USA (10 Jan 1974).

Radiation blistering can be an important erosion process when the structural components of controlled thermonuclear fusion devices or reactors are exposed to the impact of energetic particles leaving the plasma region. A brief review of some of the important parameters governing the radiation blistering process is given. Erosion rates associated with helium blistering in V, Nb, and Type 304 stainless steel are reported for different irradiation temperatures and different projectile energies. (auth)

24803 (CONF-740104-16) SEGREGATION AND SECOND PHASE FORMATION AT FREE SURFACES DURING IRRADIATION. Okamoto, P. R.; Wiedersich, H.; Das, S. K. (Argonne National Lab., Ill. (USA)). Jan 1974. 22p. Dep. NTIS $3.25.

From surface effects in controlled thermonuclear fusion devices and reactors meeting; Argonne, Illinois, USA (10 Jan 1974).

Transmission electron microscopy examinations of a number of fcc and bcc metals and alloys irradiated either by heavy-ions or high energy electrons have shown that dynamic interactions of displacement damage with impurities and alloying elements lead to segregation and/or to the formation of second phases at internal surfaces such as voids. The phenomenon has been observed in an experimental 18 Cr–8 Ni–1 Si stainless steel, in commercial 316L stainless steel, in vanadium, and in nickel. Results of analysis of the segregation-induced strain field around the voids indicate that irradiation produces an enrichment of elements with negative size factors and/or depletion of elements with positive size factors. Results of Auger spectroscopic analysis indicates a similar segregation phenomenon occurs at the external irradiated surface in 18 Cr–8Ni–1 Si stainless steel. A comparison of the Auger spectra from surfaces of unirradiated and irradiated samples show that irradiation produces an increase in the nickel and silicon concentration but a decrease in the chromium concentration. Nickel and silicon have negative size factors while for chromium, it is positive. These results suggest that undersized substitutional elements may tend to preferentially interchange positions with oversized solutes in interstitial sites, and that transport by interstitials may dominate segretation to defect sinks. (auth)

24804 (COO-2093-27) RADIATION EFFECTS ON BCC METALS AND ALLOYS. Progress Report, January 1, 1973–December 31, 1973. Moteff, J. (Cincinnati Univ., Ohio (USA)). 4 Jan 1974. Contract AT(11-1)-2093. 179p. Dep. NTIS $11.00.

Research programs directed toward evaluation of the effects of variables on the structure of bcc metals and alloys are described. Results of investigations are presented in sections on Mo, Nb, Nb–Zr alloys, W, W–Re alloys, irradiation hardening, irradiation and fatigue interactions, and compressive creep of irradiated Mo. (JRD)

24805 (COO-2317-1) STUDY OF FERRITE FORMATION IN NEUTRON IRRADIATED AUSTENITIC STAINLESS STEELS. Progress Report, June 1, 1973–February 28, 1974. Stanley, J. T.; Hendrickson, L. E. (Arizona State Univ., Tempe (USA)). 1974. Contract AT(11-1)-2317. 18p. Dep. NTIS $3.00.

A vibrating reed magnetometer was constructed for measurements on small irradiated samples. It can be operated at 4 to 500°K and can detect a magnetic moment of 4×10^{-5} erg/0_e with a signal-to-noise ratio of 20. A simple calibration procedure was devised. The magnetometer was used to measure magnetization curves of an irradiated type 316 austenitic stainless steel specimen at two different temperatures. Results confirm that the specimen contains numerous small magnetic particles which are presumed to be ferrite. Transmission electron microscopy of the irradiated specimen was not conclusive for the presence or absence of ferrite. (5 figures) (DLC)

24806 (FXM-6012) DIMENSIONAL STABILITY OF BERYLLIUM UNDER FAST NEUTRON IRRADIATION: A LITERATURE SURVEY. Zinnes, A. E. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 20 Oct 1961. Contract AT(30-1)-2789. Dep. NTIS $3.00.

Declassified 12 Sep 1973.

The results of several experimental studies of fast neutron irradiated beryllium are presented. These results indicate that only a small amount of swelling (less than 1%) occurs in the beryllium reflector of the current reactor design (PWAR-16) after 10,000 hours at an operating temperature level of about 455°C. (auth)

24807 (HEDL-TME-73-5(Vol.1), pp 2.1-14) MATERIALS ENGINEERING. Claudson, T. T. Oct 1973.

Research and development activities are summarized on mechanical metallurgy, irradiation damage analysis, and sodium technology. (JRD)

24808 (HEDL-TME-73-76) REPORT OF THE WORKING GROUP ON DISPLACEMENT MODELS AND PROCEDURES FOR DAMAGE CALCULATIONS. Doran, D. G.; Beeler, J. R. Jr.; Dudey, N. D.; Fluss, M. J. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Dec 1973. Contract AT(45-1)-2170. 85p. Dep. NTIS $5.45.

Interim procedures are recommended for the calculation of displacement rates in neutron and charged-particle irradiations and uncertainties in the procedures are discussed. Specific energy-dependent displacement cross sections are recommended for neutrons and protons. They incorporate the secondary displacement model recommended by the IAEA Working Group on Reactor Radiation Measurements. A rationalization of the secondary displacement model is included. The computer code E-DEP-1, developed by Manning and Mueller on the basis of Lindhard range-energy theory, is recommended at this time for the calculation of damage energy deposition in heavy-ion irradiations. A discussion of the problem of relating neutron and electron irradiations is presented in which it is suggested that cross sections for residual defect production, rather than displacements, should be used for correlation purposes. Recommendations are given for reporting experimental data, and the report concludes with recommendations for work that is needed to advance the utility of irradiation damage calculations. (8 tables, 6 figures, 83 references) (auth)

24809 (HEDL-TME-73-92) ULTRASONIC MEASUREMENT OF ELASTIC PROPERTIES IN IRRADIATED 304 STAINLESS STEEL. Trantow, R. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Dec 1973. Contract AT(45-1)-2170. 35p. Dep. NTIS $4.00.

System-oriented inaccuracies in early evaluations of the effect of neutron damage-induced swelling on the elastic properties of irradiated 304 stainless steel prompted the development of a second measurement approach. The new acoustic velocity measurement system was developed specifically for thin flat plate materials and employs a multiple echo technique to increase measurement sensitivity. A new series of EBR II Control Rod thimble specimens exposed to a peak fluence of 8.8×10^{22} n/cm^2 ($E > 0.1$ MeV) and undergoing a maximum swelling represented by 8.56% change in density (% $\Delta\rho/\rho_0$) were evaluated using the multiple echo system. Evaluations of the elastic moduli based on these measurements of CRT-5F3 flat 4 material show an average modulus dependency on the degree of swelling of: 1.02% change in shear modulus/% $\Delta\rho/\rho_0$; 1.70% change in bulk modulus/% $\Delta\rho/\rho_0$; and 1.12% change in Young's modulus/% $\Delta\rho/\rho_0$. An almost twofold decrease in the data error band for both Young's and Shear modulus were realized using the new measurement system. However, high attenuation in the irradiated specimens cut from the region between peak fluence and peak swelling prevented the acoustic evaluation of all specimens. (auth)

24810 (ORNL-TM-4500) RADIATION EFFECTS PROGRAM SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING JANUARY 31, 1974. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 76p. Dep. NTIS $6.00.

Research on materials for liquid metal fast breeder reactors is reported along with similar research on thermonuclear reactor materials. Results of research on the radiation behavior of Al and Al alloys are also reported along with results of fundamental studies of radiation damage in metals. (JRD)

24811 (RISO-M-1679) GRAIN SIZE DEPENDENT VACANCY SUPERSATURATION PROFILES AND THEIR INFLUENCE ON VOID FORMATION IN AN AUSTENITIC STAINLESS STEEL DURING 1 MeV ELECTRON IRRADIATION. Singh, B. N.; Foreman, A. J. E. (Danish Atomic Energy Commission, Risoe. Research Establishment). Dec 1973. 18p. Dep. NTIS (U. S. Sales Only) $3.00.

In order to study the effect of grain size on void formation during high energy electron irradiations, the steady-state point defect concentration and vacancy supersaturation profiles have been calculated for three-dimensional spherical grains up to three microns in size. In the calculations of vacancy supersaturation as a function of grain size, the effects of internal sink density and the dislocation preference for interstitial attraction have been included. The computations show that the level of vacancy supersaturation achieved in a grain decreases with decreasing grain size. The grain size dependence of the maximum vacancy supersaturation in the center of the grains is found to be very similar to the grain size dependence of the maximum void number density and void volume swelling measured in the central regions of the grains. This agreement reinforces the interpretation that the grain size effect is due primarily to the depletion of point defects from the grain interior. It is suggested that the void nucleation is strongly dependent on the level of vacancy supersaturation. (auth)

24812 (RRC-1) RADIATION DAMAGE IN REACTOR MATERIALS. (Reactor Research Centre, Kalpakkam (India)). 1973. 269p. Dep. NTIS (U. S. Sales Only) $15.50.

Information and data on radiation damage are presented in papers concerning computer simulation of radiation damage, voids in irradiated metals, damage by charged particles, low temperature irradiation facilities, structure and properties of irradiated materials, behavior of fission products in fuels, in-reactor creep, radiation damage in organic solvents, and radiation damage in RAPP type reactors. (JRD)

24813 (UCLA-34-P-172-10) PARTICLE RANGE AND ENERGY DEPOSITION IN MATERIALS CONTAINING VOIDS. Odette, G. R.; Schwartz, D. M.; Ardell, A. J. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Dec 1973. Contract AT(04-3)-34. 22p. (UCLA-ENG-7399). Dep. NTIS $3.25.

The manner in which voids affect both the range and the energy deposition of energetic charged particles in irradiated metals was investigated. Calculations of energy deposition for 5-MeV Cu^{2+} ions and 1-MeV protons incident on Fe indicate uncertainties in these quantities that increase with penetration distance. Mass density corrections adequately account for the presence of voids, except at the end of range where the contribution of void-induced straggling can be significant. The extension of the average range in these samples can be appreciable, depending upon the relationship between swelling and dose. (auth)

24814 (WAPD-TM-1078) EFFECTS OF NEUTRON RADIATION ON THE FRACTURE PROPERTIES OF A508 CLASS 2 STEEL. Hall, J. F.; Seman, D. J. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Jan 1974. Contract AT(36-1)-Gen-14. 59p. Dep. NTIS $5.00.

Effects of irradiation were evaluated by determining the shifts in the Charpy transition temperatures of 20 commercial heats and the fracture mechanics transition temperatures of four heats. Reduction in Charpy upper shelf energies with irradiation, the effects of chemical composition, and the effect of neutron spectrum on the irradiation sensitivity of A508 Class 2 material were also investigated. (7 tables, 19 figures, 18 references) (auth)

24815 LOS-CYCLE FATIGUE AND HOLD TIME COMPARISONS OF IRRADIATED AND UNIRRADIATED TYPE 316 STAINLESS STEEL. Brinkman, C. R.; Korth, G. E. (Aerojet Nuclear Co., Idaho Falls, Idaho). Met. Trans.; 5: No. 3, 792-794(Mar 1974).

Results are presented of fully reversed strain-controlled fatigue tests conducted with and without tensile or compressive hold periods, that were performed on irradiated and unirradiated specimens of Type 316 stainless steel. Results suggest that the high susceptibility to the tensile hold time effect displayed by the irradiated Type 316 stainless steel is due to further degradation of the grain boundary strength by irradiation induced damage which was probably (*n*, α) produced helium. Helium produced in the matrix can migrate to the grain boundaries at 853 to 883°K where it assists grain boundary decohesion and therefore assists intergranular fatigue cracking. (JRD)

24816 ANISOTROPY OF RADIATION DAMAGE IN ELECTRON-BOMBARDED HEXAGONAL METALS. I. DAMAGE PRODUCTION AND RECOVERY FOR MONOCRYSTALLINE COBALT, ZINC, AND CADMIUM. Maury, F.; Vajda, P.; Lucasson, A.; Lucasson, P. (Equipe de recherches du Centre National de la Recherche Scientifique, Laboratoire de Chimie Physique, F91405 Orsay, France). Phys. Rev. B 8: No. 12, 5496-5505 (15 Dec 1973).

Monocrystalline specimens of cobalt, zinc, and cadmium of various crystallographic orientations were irradiated by electrons in the energy range 0.4–1.7 MeV at liquid-helium temperature and the respective electrical-resistivity-change rates and annealing spectra in the stage I were measured. In cobalt, the maximum defect production rate occurred for the specimen bombarded perpendicularly to the (0001) plane, the minimum rates were measured for the $(11\bar{2}0)$ samples. The apparent threshold energies for displacement vary between 450 and 500 keV, in the likely order: (0001), $(30\bar{3}4)$ and $(10\bar{1}0)$, $(30\bar{3}8)$, $(11\bar{2}0)$. The largest differences in the recovery behavior of cobalt were exhibited at low energies by the $(11\bar{2}0)$ and (0001) samples. For zinc, it is difficult to distinguish between different thresholds because of the big angular spread of the electron beam at the relatively low threshold energy of ~ 350 keV. The production rates increase in the order (0001), $(11\bar{2}0)$, $(30\bar{3}4)$. Maximum recovery of the entire state I is observed for the (0001) sample, while the various substages behave quite differently as a function of crystal orientation. In cadmium, complex subthreshold behavior was observed and attributed to impurity effects. After separation of these phenomena, we deduce a minimum E_d of 630–650 keV for the (0001) orientation; after a size-effect correction, the measured resistivity-change rates are smallest for (0001), followed by $(30\bar{3}8)$ and $(11\bar{2}0)$. Two recovery regions are observed in the stage I:4–6 and 6–9 °K; at low energies, the recovery of the $(30\bar{3}8)$ sample is smallest in the first region, and at high energies, it is maximal in both regions. (auth)

24817 HIGH-PRECISION MEASUREMENTS OF LATTICE PARAMETER CHANGES IN NEUTRON-IRRADIATED COPPER. Larson, B.C. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). J. Appl. Phys. 45: No. 2, 514-518 (Feb 1974).

The dose dependence of the lattice parameter change for neutron-irradiated copper has been measured in the range (1.0–10.8) $\times 10^{18}$ neutrons/cm². The lattice parameter changes were measured directly by using a multiply reflecting monochromator, and an analysis of the effects of misalignment in the geometry has been given. The lattice parameter changes, showing a pronounced saturation with dose, were analyzed using second-order elasticity theory applied to the case of dislocation loops. (auth)

24818 ANISOTROPY OF RADIATION DAMAGE IN ELECTRON-BOMBARDED HEXAGONAL METALS. II. A MODEL FOR FRENKEL-PAIR FORMATION IN SINGLE CRYSTALS. Maury, F.; Vajda, P.; Lucasson, A.; Lucasson, P. (Equipe de recherches du Centre National de la Recherche Scientifique, Laboratoire de Chimie Physique, F 91400 Orsay, France). Phys. Rev. B 8: No. 12, 5506-5518 (15 Dec 1973).

A "geometrical" model is presented for the hexagonal close-packed lattice proposing several principal mechanisms for the displacement of a knocked-on atom. Using the experimentally determined resistivity-change rates of a previous paper and matching families of cross sections computed with this model, we have calculated sets of thresholds energies for displacement in the directions [0001], $[10\bar{1}4]$, $[10\bar{1}2]$, $[10\bar{1}1]$, and $[11\bar{2}0]$ in cobalt, zinc, and cadmium. The correlation between the resistivity-change rates and the displacement cross sections allowed the determination of the Frenkel-pair resistivity per unit concentration in cobalt and zinc: $\rho_F^{Co} \simeq 3\ \rho_{\sigma c}^{Co}$/at.%, $\rho_F^{Zn} = 3.5\ \rho_{\sigma c}^{Zn}$/at.%; no definite conclusion for ρ_F^{Cd} could be made owing to the proximity of a recovery stage. Expressions for the energies needed to pass across one or several open "windows" in the hcp unit cell were derived, including the possibility of focusing collisions in the $[11\bar{2}0]$ direction, and compared with the previously calculated threshold energies for displacement in various directions. This comparison permitted the tentative deduction of interatomic potentials of the Born-Mayer type giving as a possible choice: $U^{Co}(eV) = 3300E^{-4.1r(A)}$, $U^{Zn}(eV) = 280e^{-2.5r(A)}$, $U^{Cd}(eV) = 3000e^{-2.0r(A)}$. (auth)

24819 EFFECTS OF SELF-IRRADIATION ON THE LATTICE OF $^{238(80\%)}PuO_2$. II. Roof, R. B. Jr. (Los Alamos Scientific Lab., NM). Advan. X-Ray Anal.; 16: 396-400(1973).

From applications of x-ray analysis conference; Denver, Colorado, USA (2 Aug 1972). See CONF-720801-.

The results of the third year of observations on the effects of self-irradiation on the lattice of 238(80%)PuO_2 indicate a small but definite trend toward a reduction in the lattice parameter of this material. The lattice parameter increased from 5.41408 ± 6 Å at 5 weeks to 5.41636 ± 38 at 114 weeks and then decreased to 5.41364 ± 23 at 157 weeks after the start of the experiment. A similar trend is noted in the half-widths of the diffraction lines. For the 622 reflection the half-width increased from 0.283 ± 14°2θ at 5 weeks to 0.711 ± 90 at 114 weeks and then decreased to 0.660 ± 89 at 157 weeks. (auth)

24820 STUDY OF SLIP-BAND DEVELOPMENT ON NEUTRON-IRRADIATED Cu SINGLE CRYSTALS BY HIGH-SPEED CINEMATOGRAPHY. Neuhaeuser, H.; Rodloff, R. (Technische Univ., Brunswick). Acta Met.; 22: No. 3, 375-384(Mar 1974).

Microcinematography using a high speed film camera was applied in studying slip band development on n-irradiated Cu crystals during deformation in the yield region at room temperature. Particulars of making the films and evaluating them photometrically are reported and limits of resolution are discussed. Measured quantities taken from the films are the formation times of slip band clusters in the Lüders band, of single slip bands within clusters, and of slip lamellae within slip bands, further the characteristic times for microscopic and macroscopic cross slip, as well as the growth rate in length of slip bands. The measured data suggest that in addition to dislocation cutting through irradiation produced obstacles and cross slip processes the local constraints and work hardening play an important part in initiation, development, and termination of slip in the bands. Conclusions concerning the active crystal length and the thermal activation analysis are discussed. (auth)

24821 VOIDS IN IRRADIATED METALS. Bullough, R.; Nelson, R. S. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Phys. Technol.; 5: No. 1, 29-67(1974).

The choice of materials for the core components of fast reactors and the design of the core configuration itself depend on, amongst other things, the amount of void growth likely to occur in such components. This phenomenon of swelling was first discovered about six years ago and has been the subject of extensive research effort ever since. The present understanding of the mechanism of void growth is reviewed and the accelerator techniques that have been used to simulate the reactor environment are highlighted. The economic significance of this international research effort is also discussed. (auth)

24822 VOID FORMATION IN ION BOMBARDED NIOBIUM. Brimhall, J. L.; Kulcinski, G. L. (Battelle Pacific Northwest Labs., Richland, WA). Radiat. Eff.; 20: No. 1-2, 25-31(1973).

Transmission electron microscopy was used to study void formation in high-purity niobium bombarded with 7.5-MeV Ta^{3+} ions at elevated temperatures. The swelling due to voids increases with ion dose in the range 1 to 100 dpa at both 800 and 900°C. Above 100 dpa, the swelling begins to saturate and approaches a value of 4.5% at 800°C and between 7 to 10% at 900°C for a maximum dose of 300 dpa. The saturation is coincident with the formation of a bcc void lattice. The void lattice is somewhat temperature-dependent, being much better defined at 800°C than at 900°C. (auth)

24823 DEFECT PRODUCTION IN THORIUM BY LOW-TEMPERATURE ELECTRON IRRADIATION. Guinan, M. W. (Univ. of California, Livermore); Snead, C. L. Jr.; Goland, A. N. Radiat. Eff.; 20: No. 1-2, 33-36(1973).

The increase in the electrical resistivity of 99.98% pure thorium per unit electron flux was measured as a function of incident electron energy from 1.6 to 2.8 MeV. During irradiation, the temperature of foil samples was held below the temperature of the first major recovery peak at 10°K. For unit displacement probability, the theoretical displacement cross section best reproduces the experimental damage rates at an effective threshold displacement energy of 35 eV and a Frenkel resistivity of 15×10^{-4} ohm-cm per unit fractional concentration of Frenkel pairs. (auth)

24824 ELECTRON IRRADIATION OF Cu_3Au. Gilbert, J. (State Univ. of New York, Stony Brook); Herman, H.; Damask, A. C. Radiat. Eff.; 20: No. 1-2, 37-42(1973).

Ordered and disordered Cu_3Au were irradiated with 1- and 1.5-MeV electrons at low temperature, and subsequent isochronal annealings were obtained at different pulse times from 30 to 450°K. The initial resistivity increase per incident electron for the ordered specimens was about one-half that for the disordered specimens, suggesting that no significant radiation disordering takes place in the ordered polycrystalline samples. Irradiation with 1-MeV electrons of disordered specimens induces four annealing stages at the approximate temperatures of 90, 130, 330, and 410°K. A disordered specimen, following irradiation with 1.5-MeV electrons, exhibits all four of these stages and, in addition, two more at 55 and 190°K. These latter stages are attributed to the annealing of Au interstitials because 1.5 MeV is a sufficient electron energy to produce them but 1 MeV is not. In contrast, the ordered Cu_3Au exhibits only three stages, at 75, 240, and 410°K, for both 1-MeV and 1.5-MeV irradiations. It is proposed that focusons dissipate the energy in the ordered specimens so that Au interstitials cannot form. Tentative defect assignments are given to all stages. (auth)

24825 STUDY OF THE DISTRIBUTION OF DEFECTS PRODUCED BY ELECTRON IRRADIATION OF COPPER. Cordier, A.; Degeilh, A.; Serin, G. (CNRS, Toulouse). Compt. Rend., Ser. A, B; 277: No. 16, 455-458(22 Oct 1973). (In French).

A Cu sample was irradiated in a 1-MV electron microscope. The distribution of interstitial clusters was studied as a function of thickness and angle of incidence of the beam on low-index reflecting planes. Stereoscopy was used. The distribution is explained in terms of the localization of Bloch waves. (FR)

24826 SOLUBILITY OF NITROGEN IN LIQUID MOLYBDENUM. Domke, H.; Frohberg, M. G. (Technical Univ., Berlin). Scr. Met.; 8: No. 3, 289-292(Mar 1974).

The solubility of nitrogen in liquid molybdenum at 2650 ± 20°C was found to increase linearly with the square root of nitrogen pressure in the experimental pressure range of 50 to 500 torr. It is given by the following expression: $\text{wt. \% [N]} = 0.132 \sqrt{P_{N_2}}$. (auth)

Other Materials

Refer also to abstracts 24055, 24090, 24585, 24671, 24812, and 26236.

24827 (CEA-CONF-2356) DETERMINATION OF THE IN-PILE IRRADIATION PARAMETERS OF STRUCTURAL MATERIALS. Resistance Variation Detector. Cance, M.; Genthon, J. P.; Labrousse, M.; Mas, P.; Salon, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). Apr 1973. 12p. (In French). (CONF-730573-3). Dep. NTIS (U. S. Sales Only) $3.00.

From meeting of the Euratom working group on irradiation devices; Saclay, France (24 May 1973).

The GAMIN graphite detector is particularly well suited for determining the fluences characteristic of radioactivity induced damage of pile materials. It enables the index Σ = graphite damage flux/nickel flux, to be measured. A series of values obtained for different types of reactors in Europe are presented. A knowledge of Σ enables the graphite fluences to be determined, a simple interpretation permitting the damage fluences characteristic of other substances to be established. A tungsten detector can be used to obtain a refinement of these results. (FR)

24828 (CEA-CONF-2527) PROPERTIES AND BEHAVIOR UNDER IRRADIATION OF A GRAPHITE FOR THE FUEL BLOCK OF A HIGH TEMPERATURE REACTOR. Mottet, P.; Rappeneau, J.; Lore, J.; Cornuault, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). [nd]. 7p. (In French). (CONF-731004-7). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on nuclear fuel performance; London, UK (15 Oct 1973).

The properties of the P_3JHAN and P_3JHA_2N graphites fabricated on an industrial scale should fulfill the needs of a high temperature reactor. The fabrication of these graphites is briefly described and their properties are outlined. The dimensional variations, evolution of thermal conductivity, evolution of thermal expansion, and evolution of mechanical properties of these two graphites under neutron irradiation in the Osiris reactor are reported. (JSR)

24829 (CONF-730942-P3, pp vp Paper H 6/2) PREDICTION OF MOISTURE MOVEMENT IN HEATED CONCRETE. England, G. L.; Skipper, M. E. (King's Coll., London). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A knowledge of the manner in which water in concrete and concrete structures migrate under conditions of raised temperature is of importance in the understanding of many concrete properties and the behavior of concrete structures in service. Irreversible thermodynamic processes are used to study and predict theoretically the movement of water and air through porous media with a view to predicting moisture migration in heated concrete. The primary factors responsible for mass transfer are taken to be the pressure and temperature potentials of the system. These are then used together with numerical calculation procedures in the analysis of models representing porous bodies. Here the volume of the body is subdivided into a number of connected chambers, each at a uniform temperature, and the analysis in time proceeds in a stepwise manner as incremental mass changes take place between adjacent chambers. When temperature conditions are sustained these mass movements are accompanied by entropy changes both within the system of chambers and with the surroundings. With this information and the knowledge that the internal entropy production is always positive for an irreversible process and follows a minimum rate path, checks have been performed on the numerical calculations to minimize errors associated with the degree of subdivision of the body and the size of the time-step adopted. When the rate of movement of incremental masses is prescribed in the calculation, the steady state mass distribution is readily detected from the entropy calculations by observing the stage at which the entropy production becomes negative. Finally, the numerical results are discussed in relation to experimental data for concrete heated non-uniformly to temperatures in the range 30 to 150°C. (auth)

24830 (CONF-730942-P3, pp vp Paper H 6/3) INFLUENCE OF MOISTURE CONTENT ON THE CREEP OF CONCRETE AT ELEVATED TEMPERATURES. Zielinski, J. L.; Sadowski, A. (Politechnika, Warsaw). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

There is a general opinion that the properties of concrete have to be tested on specimen under simulated vessels conditions. One of the factors which may seriously affect the concrete behavior is the water content. Some tests have been undertaken with the aim to elucidate the influence of water content on creep at elevated temperatures. The tests were carried out on dry concrete specimens as well as on specimens at various ($\frac{1}{3}$, $\frac{2}{3}$, 1.0-natural) moisture content at normal (20°C) and elevated temperatures (60°C). The ratio of creep at elevated temperature to that at normal one, have been found constant (in the range of tested temperature) irrespective of time and water content, under the condition that the water content in the compared specimen remained constant. These tests showed that among various factors which might affect creep at elevated temperatures, content of water in the concrete can not be neglected; in the tests of creep of concrete at elevated temperatures constant water content in the compared specimens has to be assured. (auth)

24831 (SLA-73-5760) CHARACTERIZATION OF SILICON METALLIZATION SYSTEMS USING ENERGETIC ION BACKSCATTERING. Borders, J. A.; Picraux, S. T. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 35p. Dep. NTIS $3.75.

Silicon metallization systems have become increasingly sophisticated in order to tailor contact properties such as adhesion, electrical conductivity, barrier height, and long-term reliability. These contact properties are highly susceptible to solid–solid reactions, typically involving atom migration over distances less than 1 μm. Analysis by monoenergetic ion beam irradiation is a valuable new materials characterization technique to optimize process parameters and contact lifetime. Energy analysis of the backscattered ions allows nondestructive determination of the depth distribution of the atomic composition of thin multilayered systems. Recent application of this technique has provided extensive data on the energetics and kinetics of interdiffusion and compound formation for thin film metallizations on silicon, particularly those used in silicon device technology. The results of these studies are reviewed and systematized. Interdiffusion results are treated for silicon-metal and metal–metal reactions. Distinction is made between cases where internal surface transport effects dominate and cases where compound formation dominates. Examples are taken from each of these areas and are discussed in terms of metallurgical properties. (auth)

24832 METHOD FOR PROVIDING METALLIC CARBIDE COATINGS ON GRAPHITE. Napier, J. M.; Caputo, A. J. US Patent 3,781,173. 25 Dec 1973. Filed date 12 Jan 1971. 6p.

Metallic or nonmetallic carbide coatings of substantially uniform thickness are provided on internal surfaces of elongated bores within a graphite substrate by vapor deposition. The coating process is achieved by the thermal decomposition of a selected halide and the inter-reaction with a hydrocarbon gas at temperatures of 900 to 1200°C. at atmospheric pressure. A temperature gradient along the length of the bore is used to control the coating deposition rate for providing a carbide coating of substantially uniform thickness. (Official Gazette)

24833 X-RAY-DIFFRACTION MEASUREMENT OF THE ANISOTROPY OF THE PYROCARBON IN HTR FUEL PARTICLES. Pluchery, M. (CEN, Grenoble, France). Mater. Res. Bull.; 9: No. 3, 251-264(Mar 1974). (In French).

An x-ray diffraction technique for measuring the anisotropy factors of pyrocarbon coatings on fuel particles for high temperature reactors was developed. The measurements yield directly absolute values of BAF averaged over about 100 particles, with an accuracy of ±0.01. A modified procedure for measuring a single irradiated particle is considered. BAF-values obtained from discs and from particles coated in the same run do not exhibit any simple correlation. (7 figures, 19 references) (auth)

24834 EXPERIMENTAL STUDY OF THE SUBLIMATION OF GRAPHITE AT HIGH TEMPERATURES. Zavitsanos, P.D. (General Electric Company, Re-Entry and Environmental Systems Division, Philadelphia, Pennsylvania 19101); Carlson, G.A. J. Chem. Phys. 59: No. 6, 2966-2973 (15 Sept 1973).

The equilibrium vaporization of pyrolytic graphite was studied using rf induction heating and a time-of-flight mass spectrometer. rf induction heating was demonstrated for the first time as a compatible and practical heating technique for high temperature mass spectrometry. Relative ion intensities were measured for $C_1(g)$, $C_2(g)$, $C_3(g)$, and $C_4(g)$ in the temperature range 2320 K–3000 K and partial vapor pressures were obtained. The vapor pressures of C_2 and C_3 in the temperature range 2400 K–3000 K can be represented by $\log P(C_2)$ (atm) $= 9.971 - 44230/T(K)$ and $\log P\ (C_3)$ (atm) $= 9.944 - 40670/T(K)$. Heats of vaporization obtained by the second and third law methods are as follows:

Species	Second law ΔH^0_{298}(kcal/mole)	Third law ΔH^0_{298} (kcal/mole)
C_1	170.3 ± 1.1	
C_2	206.0 ± 1.3	202.7 ± 0.6
C_3	194.4 ± 1.2	202.1 ± 1.5
C_4		242.7

Thermodynamic functions calculated by Strauss and Thiele were used for C_3. JANAF thermodynamic data were used for all other species. The entropy change in the vaporization of C_3 determined from this work is 45.55 eu at 2740 K.

24835 ELECTRIC RESISTIVITY OF MONOCRYSTALLINE U_3As_4 IN VICINITY OF THE CURIE TEMPERATURE IN AN EXTERNAL MAGNETIC FIELD. Henkie, Z.; Klamut, J. (Inst. for Low Temperature and Structure Research, Wroclaw). Phys. Status Solidi (a); 20: No. 1, K69-K72(16 Nov 1973).

The temperature dependence of the electric conductivity of [111] and [100] U_3As_4 crystals was measured in external fields up to 3 kOe. Results show a maximum near T_c (198°K), which shifts, flattens, and eventually disappears with increasing field. The magnetic domain structure is destroyed by the external magnetic field. (DLC)

24836 OPTICAL PROPERTIES OF ELECTRON-IRRADIATED TYPE Ia DIAMOND. Davies, G. (King's Coll., London). Proc. Roy. Soc. (London), Ser. A; 336: No. 1607, 507-523(19 Feb 1974).

Measurements are reported on the visible and near ultraviolet spectra of type Ia diamonds after room-temperature electron irradiation. The temperature dependence of the GR1 doublet was determined in diamonds of low nitrogen content between 9 and 130°K. It is shown that these data enable limitations to be placed on the degeneracies, and hence irreducible representations, of the electronic states of the GR1 centre. With increasing nitrogen content, the GR1 doublet is found to become complicated by the growth of extrinsic structure. This is shown to result from some GR1 centres having migrated to specific sites close to the nitrogen, so that their symmetry is lowered, lifting the orbital degeneracies. ND1 centres are found to be produced in proportion to the GR1 centres, regardless of the nitrogen content, once the diamonds are recognizably type Ia. Again, in diamonds of high nitrogen content, some ND1 centres are severely perturbed by the nitrogen, resulting in the ND1 zero-phonon line's long tails. Annealing rapidly destroys these perturbed centres as the nitrogen captures them. The ND1 line width is then only slightly dependent on the nitrogen content, in agreement with the stress coupling parameters of the ND1 line. Attention is drawn to the 503.6 nm band, which has probably been confused in the past with the H3 line at 503.2 nm. The 503.6 nm band may be formed in any diamond; in type Ia diamond its strength is found to be proportional to the radiation dose and, approximately, to the nitrogen content. It is rapidly annealed out. (auth)

24837 INVESTIGATION OF RADIATION DEFECTS IN SEMICONDUCTOR COMPOUNDS OF TELLURIUM BY THE MÖSSBAUER EFFECT. Savin, É.P.; Seregin, P.P. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Solid State 15: No. 4, 877-878 (Oct 1973).

Radiation defects, from the reaction $^{128}Te(n,\delta)^{129m}Te$, produced in $BiTe_3$, SnTe, PbTe and GeTe are studied as a function of neutron irradiation dose by Mössbauer spectroscopy. (AIP)

24838 PRODUCTION OF TREEING IN INSULATORS AT DAMAGE TRACKS. Tommasino, L.; Armellini, C. (Laboratorio di Dosimetria e Standardizzazione, CNEN, C.S.N., Casaccia, Roma, Italy). J. Appl. Phys. 45: No. 2, 949-950 (Feb 1974).

In most insulators heavy ions produce tracks of radiation-damaged material which give rise to microscopic channels after appropriate chemical etching. By applying high-voltage pulses through the irradiated insulator kept between two electrolyte cells containing the etching reagent, these damage tracks cause treeing phenomena. Preliminary results are shown dealing with the treeing production around fission fragment and α-particle tracks in some organic insulators. Treeing at damage tracks provides a new method for initiating treeing processes and enables us to enlarge damage tracks considerably. (auth)

24839 RADIATION RESISTANCE OF ACETAL COPOLYMERS. Wolters, E.; Roesinger, S. (Farbwerke Hoechst AG, Frankfurt am Main). Kunststoffe; 63: No. 9, 605-608(1973). (In German).

For the radiation sterilization of equipment and containers made from plastic material, a dose of 2.5×10^4 J/kg (2.5 Mrad) is normally used. Experiments are described which show the influence of the sterilization doses applied in practice on the physical properties of the acetal copolymer Hostaform. Although a certain destruction and simultaneously a reduction in viscous properties are observed as a result of irradiations with gamma rays up to 2.5×10^4 J/kg, the tensile strength remains practically unchanged. Hence γ-ray sterilization can be applied if there are no special requirements as to the mechanical properties of the sterile equipment. (GE)

24840 EPR OF HOLE CENTERS IN KCl CRYSTALS X-IRRADIATED AT TEMPERATURES OF 175 TO 227°K. Gorbenko, P. K.; Ezhov, N. M.; Telyatnik, A. I. (Kiev Polytechnical Inst.). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 10, 1742-1743(Oct 1973). (In Russian).

In KCl crystals prepared from carefully purified salts and x-irradiated at temperatures from 175 to 227°K, EPR signals were detected from hole centers which were described by the spin Hamiltonian of the form $\mathcal{H} = \beta HgS$. The angular dependence of the spectrum was studied and the principal values of the g tensors ($g_{zz} = 2.001 \pm 0.001$, $g_{xx} = 2.007 \pm 0.001$, $g_{yy} = 2.020 \pm 0.001$) and the directions of their principal axes ([110], [$\bar{1}\bar{1}$0], [001] respectively) were established. It was concluded that in the composition of the centers detected interstitial Cl atoms were introduced. (tr-auth)

24841 SILICONE CABLES FOR NUCLEAR PLANTS. Elec. World; 181: No. 2, 68-69(15 Jan 1974).

The construction of the Calvert Cliff's No. 2 unit is 75% completed, and is the first power plant to rely upon silicon-rubber-insulated electric cables for nearly all instrumentation, control, and small power appliances. Testing proved that only silicone rubber could provide the necessary degree of survivability in the smaller sizes during a fire. The silicone-rubber cables passed strenuous fire resistance testing at 1800°F. Tests showed chemical properties and stability in a radiation environment are excellent. (MCW)

24842 PROTON CHANNELING IN NaCl SIMULATION OF CHANNELING AND X-RAY EXCITATION. Roth, S.; Sizmann, R. (New York Univ., NY). Radiat. Eff.; 20: No. 1-2, 43-53(1973).

In alkali halide crystals, two classes of directions can confront a particle beam in a channeling experiment. Some directions (⟨100⟩ e.g.) contain alternating cations and anions while others (⟨110⟩ e.g.), composed of only cations or anions, alternate in the crystal. The channeling of 75-keV protons and their (K) x-ray production along ⟨100⟩ and ⟨110⟩ was investigated by a computer simulation in NaCl at 80 and 280°C for comparison with measurements of x-ray channeling dips. The simulation included thermal lattice vibrations, impact parameter-dependent electronic energy loss, and (K) x-ray excitation. Along ⟨100⟩, the normalized x-ray yield profiles for Na(K) and Cl(K) are identical within the statistics of the computations and agree with the dechannelled fraction for small incident angles. But along ⟨110⟩, more Na(K) than Cl(K) x rays are produced (normalized to the respective random yields), in accord with the result that dechanneling occurs mainly at Na rows owing to their weaker row potentials. (auth)

24843 THERMOLUMINESCENCE OF X-IRRADIATED KCl AND KCl : LiCl CRYSTALS. Gorbenko, P. K.; Kovtun, A. A.; Popova, O. A. (Kiev Polytechnical Inst.). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 10, 1744-1745(Oct 1973). (In Russian).

The mechanism of the complete decoloration of high purity KCl crystals, x-irradiated at room temperature, is studied. One thermoluminescent peak with a maximum at 450°K is observed in the spectrum of the pure crystal. Two luminescent peaks at 360 and 480°K (all peaks of the first order) are detected on the thermoluminescent curve of x-irradiated mixed crystals of KCl + 1 mol % LiCl. Activation energies of 0.62, 0.58, and 3.12 eV correspond to the peaks at 360, 450, and 480°K respectively. The high-temperature thermoluminescent peaks of KCl : LiCl are characterized by very high parameters in comparison with the parameters of the thermopeaks of pure KCl. It is concluded that the total thermoluminescence of pure KCl proceeds as a result of diffusion and annihilation of hole centers with F centers provided the pure and impure x-irradiated crystals differ only by the hole components. (tr-auth)

24844 HIGH-CURRENT LIGHTNING SIMULATION TESTING OF COMPOSITE MATERIALS. Schulte, E. H. (McDonnell Aircraft Co., St. Louis). J. Environ. Sci.; 16: No. 3, 19-26(1973).

Analytical modeling of the response of composite materials, such as boron/epoxy and graphite/epoxy, to a lightning-induced shock is extremely difficult, due principally to the complex electrical and mechanical structure of these materials. Such models should be verified by laboratory lightning strike tests. These strikes should be simulated as realistically as possible since the damage mechanisms (electrical, magnetic, thermal, and pressure) are highly dependent upon the characteristics of the high current lightning stroke. The approach used in lightning simulation testing with peak currents of 200,000 amperes and charge transfers of several hundred coulombs in a second are described. (auth)

24845 ELECTRON DRIFT AND HALL MOBILITY IN γ-IRRADIATED 10M NaOH GLASSY ALKALINE ICE. Huang, T.; Eisele, I.; Kevan, L. (Wayne State Univ., Detroit). Contract AT(11-1)-2086. J. Chem. Phys.; 59: No. 12, 6334-6349(15 Dec 1973).

The drift and Hall mobility of electrons in 10M NaOH glassy alkaline ice has been studied to determine the relevant charge transport mechanisms in this disordered system. The electrons are photoexcited to a conduction state after being trapped in the matrix at 77°K by γ irradiation. The dominant electron scattering mechanisms have been deduced from variation of voltage and temperature, and it appears that electron transport in this matrix is well characterized by a band model. Field dependent mobilities are observed and indicate that hot electron effects exist. In the field independent mobility region, the limit of which depends on temperature, the dominant mechanism is scattering by acoustical and optical phonons. This holds above 77°K and probably to much lower temperatures. In the field dependent mobility region, the dominant mechanism is ionic species scattering, notably by O^-, at lower temperatures, and acoustical and optical phonon scattering at higher temperatures. The dividing temperatures decreases with increasing field and is ~50°K at 4 kV cm^{-1}. At constant temperature versus field, the mobility is dominated by phonon scattering in the field independent mobility region, by ionic species scattering in the initial part of the field dependent mobility region, and by phonon scattering again at high fields. Drift mobility, Hall mobility, and photoconductivity results all interrelate and give a consistent picture of electron transport in 10M NaOH. The super-Ohmic photocurrents, previously observed, are seen to be due to dominance of ionic species scattering. The temperature and field dependence of the mobility is satisfactorily predicted by a simple band model and the mobility magnitude is at least semiquantitatively predicted. However, the critical field, at which hot electron effects occur, is predicted to be too high by the band model. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstract 24284.

24846 (ARH-SA-182) PLUTONIUM BLENDING MODEL. Mangan, F. K. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 14 Jan 1974. Contract AT(45-1)-2130. 23p. (CONF-740109-1). Dep. NTIS $3.25.

From second inter-divisional management science meeting; Palm Springs, California, USA (28 Jan 1974).

As a part of its contract with the Atomic Energy Commission, the Atlantic Richfield Hanford Company has been charged with the task of choosing those items from the plutonium inventory which should be mixed to meet various blending programs. In the past, this task has been handled manually with somewhat less than optimal results. Currently the task is being performed on the computer by the ARHCO Plutonium Blending Model. The model and background information are discussed. (auth)

24847 (BLG-486) CONTRIBUTIONS TO THE JOINT SAFEGUARDS EXPERIMENT MOL IV AT THE EUROCHEMIC REPROCESSING PLANT, MOL, BELGIUM, June 15, 1973. Beets, C. (Ed.). (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Sep 1973. 121p. Dep. NTIS (U. S. Sales Only) $8.25.

A separate abstract was prepared for each of the six sections of the report. (TFD)

For abstracts of individual sections see: 24848–24853.

24848 (BLG-486, pp 1-6) DETERMINATION OF THE URANIUM CONCENTRATION IN DISSOLVER SOLUTIONS BY MEANS OF DENSITY MEASUREMENTS. Beets, C.; Bemelmans, P.; Franssen, F.; Pirard, R. (CEN, Mol, Belg.). Sep 1973.

A fast, simple and accurate method of determination of uranium in the input solutions to a reprocessing plant has been developed by an extension of Burger's formulas. The accuracy of the method is that of the reference mass spectrometer which serves for the calibration, and, because the time of response is very short (about 2 hr) the random error can be cut down through repetition of the measurements. The interference of fission products is relatively weak in regard of the large amounts present, so that there is hope that the method will be universal, i.e., very insensitive to the type of fuel at hand. The method of course still relies on sampling, but it should be noted that the density is the reference parameter for deciding the representativeness of the samples taken for other measurements. This method is adequate for both safeguards and process control purposes. (BE)

24849 (BLG-486, pp 1-38) APPLICATION OF HEAVY ELEMENT ISOTOPIC CORRELATION SAFEGUARDS TECHNIQUES TO SENA, DOUGLAS POINT 1 AND TRINO REACTOR FUELS. Preliminary Contributions to the Mol IV-A Experiment. Christensen, D. E.; Schneider, R. A.; Reppond, E. B. (Battelle Pacific Northwest Labs., Richland, WA). Sep 1973.

Reprocessing of spent reactor fuels by Eurochemic at Mol, Belgium, has provided and continues to provide measured data useful in the development of isotopic correlation safeguards techniques. The purpose of applying isotopic correlations to uranium and plutonium concentration and isotopic data from the head-end accountability as well as product samples is to verify the measured plutonium content of fuels that are reprocessed. Recently, as part of the Mol IV experiment, spent fuels from the SENA, Douglas Point 1 and Trino reactors have been reprocessed (referred to as Mol IV-A). Results from applying isotopic correlations to the measured data which are presently available are presented. (BE)

24850 (BLG-486, pp Be 1-Be 8) GAMMA MEASUREMENTS ON SENA SPENT FUEL ASSEMBLIES AND DISSOLVER SOLUTIONS. Beets, C.; Bemelmans, P.; Pirard, R. (CEN, Mol, Belg.). Sep 1973.

The aim of the described experiment is to verify to what extent the operator's declaration about burnup can be checked by means of simple routine measurements. High resolution gamma spectrometry of fission products was selected mainly because of its relative ease of implementation. The relative abundances of fission product nuclides in an individual fuel assembly are functions of the irradiation history and of the time elapsed after removal from the reactor. The simplest case is that of the ^{137}Cs nuclide which is produced by simple decay of the mass-137 chain to the long-lived (30y) isotope. Because the capture cross section is quite small, the concentration of ^{137}Cs atoms is a direct measure of the integrated number of fissions which have occurred in the fuel. The ^{134}Cs/^{137}Cs activity ratio is a very convenient burnup monitor. Probably for many types of fuel assemblies (PWR, MTR) it will be adequate to calibrate single-spot (along fuel assembly) gamma spectrometric measurements of this ratio against known burnups and to use this calibration for further routine determination of burnup. For SENA, the technique was succesfully applied to both the fuel assemblies and dissolver solutions. (BE)

24851 (BLG-486, pp Br 1-Br 5) GAMMA MEASUREMENTS ON TRINO FUEL ASSEMBLIES. Bresesti, M. (EURATOM, Ispra, Italy); Peroni, P. Sep 1973.

In the framework of a cooperative program between ENEL and EURATOM, gamma spectrometry measurements were performed on twelve fuel assemblies of the 257 MW(e) TRINO VERCELLESE PWR to study the correlations existing between radioactive fission products and the burnup and plutonium content. These assemblies reached a burnup between 19,000 and 22,000 MWD/MTU; six of these assemblies had a 3.13% enrichment, the other a 3.90% enrichment in ^{235}U. The gamma detection line consisted of a Ge(Li) detector connected through an ADC to a 4 K computer. A mechanical and collimation system permitted measurements to be performed at different levels on the four corners of the fuel assemblies in the spent pond of the TRINO VERCELLESE plant. The gamma ray activities of the fission products were correlated with values of burnup and plutonium content generated by the BURSQUID, a two dimensional burnup code, in the three neutron group version (two thermal and one fast). (BE)

24852 (BLG-486, pp Ko 1-Ko 4) FISSION GAS CORRELATIONS. Koch, L.; Gerin, F.; de Meester, R. (European Inst. of Transuranium Elements, Karlsruhe, Ger.). Sep 1973.

During the Mol IVa experiment, samples of dissolver off gas and dissolver solutions were analyzed in the TU-Institute in order to study the feasibility of fission gas correlations. The sampling of the dissolver off gas took place at a bypass of the main off gas line located at the exhaust chimney. The three samples of the Sena fuel and 2 samples of the Trino fuel reprocessing batches were analyzed for the isotopic concentration of ^{235,236,238}U, ^{238,239,240,241,242}Pu, ^{241,243}Am, ^{242,244}Cm, ^{143,144,145,146,148,150}Nd. The ^{148}Nd concentration was used to determine the burnup. (BE)

24853 (BLG-486, pp Le 1-Le 9) CONTRIBUTION TO THE INVESTIGATION OF ISOTOPIC CORRELATIONS AMONG NON-DESTRUCTIVE MEASUREMENTS ON FUEL RODS. Leenders, L. (CEN, Mol, Belg.). Sep 1973.

One of the tasks of the Reactor Physics Department of C.E.N./S.C.K. is to provide experimental data for the calibration of reactor codes. After having completed an extensive program of critical experiments to achieve reactor code calibration at start of life conditions, this task was completed by checking these codes when predicting burnup or other fuel parameters during irradiation. A first step in this way is to provide SENA reference data in close collaboration with the French CEA and the BELGONUCLEAIRE. This collaboration work is devoted to post-irradiation experiments on one of the highest burnup fuel assemblies of each of the first three unloaded SENA batches. The experiments consist of nondestructive tests (γ-scanning made by C.E.N./S.C.K.) and destructive ones (isotopical analysis, oscillation measurements made by CEA). Although these experiments were not carried out for safeguards purposes, it is evident that they are based on similar techniques and it seems that some of the results may be useful in solving safeguards problems. (BE)

24854 (LA-5485-M) UF$_6$ ENRICHMENT MONITOR: OPERATING PROCEDURES MANUAL. Reilly, T. D.; Martin, E. R.; Parker, J. L. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1974. Contract W-7405-eng-36. 17p. Dep. NTIS $4.00.

This manual describes the construction and operation of a UF$_6$ enrichment monitor for the continuous measurement of percent ^{235}U and percent ^{234}U in a liquid UF$_6$ stream. The system uses a gamma enrichment meter to measure ^{235}U and ^{3}He neutron detectors to measure ^{234}U. It is presently installed at the Goodyear Atomic Corporation gaseous diffusion plant in Piketon, Ohio. (auth)

24855 (RCN-200) GLOSSARY OF TERMS USED IN NUCLEAR SAFEGUARDS. Zijp, W. L. (comp.). (Stichting Reactor Centrum Nederland, Petten). 11 Jan 1974. 34p. (CONF-740308-1). Dep. NTIS (U. S. Sales Only) $3.75.

Descriptions of concepts in the field of nuclear safeguards with definitions in English, and with term titles in English, French, German, Italian and Dutch are presented. (auth)

24856 (RCN-201) SOME STATISTICAL TESTS RELEVANT TO NUCLEAR MATERIAL ACCOUNTANCY AND SAFEGUARDS. Zijp, W. L. (Stichting Reactor Centrum Nederland, Petten). 9 Jan 1974. 65p. (CONF-740308-2). Dep. NTIS (U. S. Sales Only) $5.25.

From European safeguards research and development symposium; Rome, Italy (7 Mar 1974).

A selected number of statistical tests which can be applied to derive conclusions on the average result (central tendency) and the scatter (variability) of a series of observations are presented. Although the description of the procedures and the examples are quite general, and not specific for material accountancy and safeguards, the selection has been prepared in relation to the work of the ESARDA working group on systems analysis. For the ease of the compiler the examples have been taken from several literature references. All statistical tables needed for application of the procedures presented are included at the end of the report. (auth)

Disposal and Storage

Refer also to abstracts 24089 and 24096.

24857 (DP-1349) CONTROL AND TREATMENT OF RADIOACTIVE LIQUID WASTE EFFLUENTS AT THE SAVANNAH RIVER PLANT. Jacobsen, W. R.; Marter, W. L.; Orth, D. A.; Ross, C. P. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Feb 1974. Contract AT(07-2)-1. 124p. Dep. NTIS $5.45.

Radioactive waste effluents at the Savannah River Plant are treated on the basis of potential off-site effects. Those wastes that are not stored in tanks or released directly to plant streams are either discharged to seepage basins or treated further to reduce their activity before being discharged. Administrative controls require that releases not result in harmful consequences and that they are also kept as low as practical. This document describes the controls, documents the releases of radionuclides to seepage basins, and describes other methods used to treat radioactive liquid wastes. (auth)

24858 (WASH-1530) ADDITIONAL HIGH LEVEL WASTE FACILITIES. Environmental Statement. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Plant). Jan 1974. 86p. Dep. NTIS $6.50.

In the continuing production of nuclear material for national defense at the Savannah River Plant, highly radioactive waste byproducts are generated. (No wastes from commercial power reactor fuels are generated or stored at Savannah River Plant.) These wastes are being stored initially as liquids in buried, near-surface storage tanks. After suitable decay of short-lived radioactive isotopes, the waste solution is being evaporated and returned to interim storage in the waste tanks as a soluble, retrievable salt cake. Additional waste tanks and evaporators are needed to meet forecast production of nuclear materials, and to replace older tanks which will be removed from service for detailed examination. The proposed addition to present waste management facilities will consist of six 1.3-million gallon high activity waste tanks, a waste evaporator, and associated auxiliaries. These facilities will be located in F and H Area tank farms on the basis of production requirements and the need for tank retirement. The waste tanks will be constructed of mild steel, each enclosed in a steel-lined concrete containment vessel. The budgeted cost of the tanks, evaporator and auxiliaries is 30 million dollars. Design of the tanks will be similar to that of the last six tanks built at the Savannah River Plant. The proposed tanks will incorporate the latest technology pertaining to fabrication, stress relieving, inspection techniques and acceptance testing. Special consideration will be given to improved methods of integrity monitoring and safe operating techniques. (TFD)

24859 (WASH-1532) RADIOACTIVE WASTE FACILITIES. Environmental Statement. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. 77p. Dep. NTIS $6.00.

The Environmental Statement was prepared in accordance with the National Environmental Policy Act of 1969 in support of the Atomic Energy Commission's proposal for legislative authorization and appropriations for the project. The purpose of the proposed project is to provide new facilities to supplement and upgrade existing facilities for handling intermediate level liquid wastes (ILW) generated by Oak Ridge National Laboratory (ORNL) operations. These facilities will include a waste evaporator and its associated tanks to be located in Bethel Valley in the approximate center of the ORNL site; waste collection and storage tanks to be located in Melton Valley, approximately a mile from the waste evaporator facility; and a waste transfer line connecting the two facilities. The waste evaporator will be similar in design to the existing waste evaporator, with a capacity of 600 gal/h, and will serve as backup to the existing evaporator. The new tanks will be similar in design to those currently being built at other AEC sites and will permit operation of the ORNL waste handling system without use of the existing tanks. (TFD)

24860 PROBLEMS OF NUCLEAR POWER PLANTS AND THEIR WASTES. Technica (Basel); 22: No. 15, 1443-1448(Jul 1973). (In German).

The following complex questions are discussed: of what kind and amount are the radioactive materials coming from different parts of the nuclear fuel cycle; what are the principles applied and the laws, regulations and international agreements on the storage or disposal of radioactive wastes; and which methods for the treatment and storage of radioactive materials have been developed and proved to be suitable. (GE)

24861 TECHNICAL AND SOCIAL ASPECTS OF NUCLEAR WASTE DISPOSAL IN WESTERN EUROPE. Rose, D. J. (Massachusetts Inst. of Tech., Cambridge); Tenaglia, G. Ambio; 2: No. 6, 233-240(1973).

Disposing of radioactive wastes from nuclear reactors poses combined technical and social problems. Useful new technical options seem available (e.g., perhaps eliminating very long-lived wastes from the stored burden by recycling them in reactors). Social issues need more attention. It is suggested that as a minimum each nation opting for nuclear power be prepared to accept its processed wastes for storage because individual states and their successors have greater continuity than do international institutions. With that base, international agreement will more easily follow. (auth)

24862 RADIOACTIVE WASTES IN BIOLOGICAL RESEARCH INSTITUTIONS. Kirchmann, R. (CEN, Mol, Belgium). J. Belge Radiol.; 56: No. 5, 443-450(1973). (In French).

The different radioelements used in the Belgian Biological Research Laboratories and the activities used are indicated. The types of utilization of ^{3}H, ^{14}C, ^{32}P, ^{125}I, ^{131}I, ^{85}Sr, and ^{226}Ra are given. The handling procedures for contaminated wastes of these radionuclides are described. The release of radioactive waste by all the laboratories which were investigated is estimated. (auth)

24863 COPING WITH NUCLEAR WASTES. Davis, J. C. Chem. Eng.; 81: No. 2, 82; 84(21 Jan 1974).

The US Atomic Energy Commission has undertaken new projects for reducing volume and for packaging radioactive wastes in order to reduce the amount of surveillance needed at the sites for storage. A $40-million bedded-salt pilot plant for storage of nuclear waste is planned, but no site has been chosen, but is scheduled for operation in the 1980's. A variety of surface-storage alternatives using water basins, air-cooled vaults, or sealed storage casks (perhaps in New Mexico) is being investigated. At Hanford, research continues on a solidification project to convert the wastes to rock-hard materials. Low-level radioactive wastes generated during the operation of nuclear plants or the fabrication or processing of the fuel is being digested by acid in a new method. The Powdex process is a new powdered-ion-exchange system of condensate purification. Sulzer Bros. is developing a process to utilize radioactive wastes to sterilize sludge, fit for agriculture afterwards. (MCW)

Handling Equipment and Procedures

24864 (GAT-777) EMERGENCY SEALING DEVICE FOR CYLINDER VALVES. (Goodyear Atomic Corp., Piketon, Ohio (USA)). 8 Feb 1974. Contract AT(33-2)-1. 6p. Dep. NTIS $4.00.

A new emergency sealing device, the Osborne Valve Capper, has been designed at the Portsmouth Area Gaseous Diffusion Plant for sealing off leaking uranium hexafluoride cylinder valves. Defective valves caused by corrosion of valve body and stem seats or galling of valve components must be sealed as quickly and efficiently as possible under emergency conditions to minimize health and safety hazards resulting from the release of uranium hexafluoride to the working environment. The Osborne Valve Capper, a stainless-steel, clamp-like device that can be quickly hooked over a cylinder valve, contains a tapered Teflon-faced plug that can be forced into the cylinder valve port opening by turning a knob on a hand wheel located on the capper. Photographs of this device are shown and a drawing showing the engineering design and actual dimensions is presented. The Osborne Capper is intended for use on Superior No. 5665 and Superior No. 11246 (or equals) cylinder valves that are used on 5, 8, and 12-in. and

30 and 48-in. uranium hexafluoride cylinders, respectively. However, this sealing device may be used on any similar cylinder valve with an opening of $\frac{1}{4}$ to 1 in. Potential application exists for use of the Osborne Valve Capper to seal any leaking cylinder valve containing toxic gases as well as uranium hexafluoride. (auth)

24865 (STI/PUB-358) SAFE HANDLING OF PLUTONIUM: A PANEL REPORT. Safety Series No. 39. (International Atomic Energy Agency, Vienna (Austria)). 1974. 132p. IAEA $6.00.

One aspect of the peaceful application of atomic energy in the near future is the expected increase in the use of plutonium, particularly for energy production and in research work. The safety aspects of handling this material require careful attention, and this report is directed to workers in research laboratories handling it in gram amounts. The report discusses the various features of the handling facilities, describing the glove boxes and giving the requirements for the ventilation systems; it also deals with the question of health surveillance. The report does not deal with criticality considerations, since it is intended for workers in plutonium facilities in which the total amount of the fissile material present at any moment is low enough not to require criticality considerations. (auth)

24866 (Y-DR-120) CRITICAL EXPERIMENTS WITH ENRICHED URANIUM DIOXIDE. Magnuson, D. W. (Oak Ridge Y-12 Plant, Tenn. (USA)). 30 Nov 1973. Contract W-7405-eng-26. 27p. Dep. NTIS $3.50.

Array critical experiments have been performed with small and large enriched UO_2 units, with external moderator between units and with internal moderator in the form of an alcohol-UO_2 slurry. Calculated multiplication factors of the experimental arrays, derived from the KENO Monte Carlo code and Hansen-Roach 16-group cross sections, were in satisfactory agreement with the observed values, i.e., $|\Delta K| < 0.01$. These experiments and calculations have demonstrated further the capability of the Hansen-Roach cross sections used in various reactor codes to predict criticality for enriched uranium. (auth)

24867 MACHINE TOOL FOR MULTIPLE OPERATIONS, PREFERABLY FOR NUCLEAR APPLICATIONS. Gillot, R.; Montellanico, P.; Righino, E.; Sgarlata, A. (to Commission of the European Communities). Luxembourg Patent 63,640. 29 Jul 1971. 1p. (In French).

A multiple operation remote-controlled machine for nuclear applications is described. It can loosen, unscrew, weld, and screw radioactive materials and objects. It consists of a plate on which are fixed a rotating pan with movable jaws, a turret with a tool holder for the different operations, and a column with a vertically moving slide. The monoreducer group for the pan is arranged under the plate. The mechanical transmission for the advance and retreat of the tool holder and the slide and the linking for the vacuum pump and gases is attached to the plate. A removable glass cover is over the plate. (tr-auth)

24868 NEW LIGHT-DUTY POWER MANIPULATOR. Koehler, W.; Selig, M. (Kernforschungszentrum, Karlsruhe, Ger.). Kerntechnik; 15: No. 12, 561-564(Dec 1973). (In German and English).

An electrically powered manipulator (Type SM3-A) for the manipulation of radioactive objects is described. This light-duty device is capable of exerting forces of almost the same order as a conventional medium-heavy duty power manipulator. Owing to its radiation and temperature resistance, mobility and versatility, it fills a gap in the range of manipulators offered by German manufacturers. (GE)

Transportation

Refer also to abstract 24392.

24869 DEVELOPMENT OF THE IAEA REGULATIONS FOR THE SAFE TRANSPORT OF RADIOACTIVE MATERIALS. Fairbairn, A. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). At. Energy Rev.; 11: No. 4, 843-889(Dec 1973).

A review is presented of the development of the regulations published by the International Atomic Energy Agency between 1961 and 1973 on safe transport of radioactive materials. Aims and basic concepts are described, followed by a survey of regulatory prescriptions relevant to containment of radioactive material, control of radiation, safe dissipation of heat and prevention of criticality. In conclusion, some remarks are made on future developments. (auth)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 26310.

24870 (AD-767645-5-GA) REPORT OF CYCLOTRON OPERATION, 1 January–31 December 1972. (Naval Research Lab., Washington, D. C. (USA)). Sep 1973. 140p. (NRL-MR-2635). NTIS $4.50.

The research program at the NRL Sector-Focusing Cyclotron during the year 1972 is described. The basic research program is devoted primarily to problems involving nucleon systems and light nuclei. Experimental results of deuteron breakup by protons are compared with exact calculations, and it is concluded that the calculations are not yet using the proper nuclear potential. The problem of deuteron breakup by deuterons has been investigated with the conclusion that it is not necessary to invoke a singlet final state interaction to explain observed spectra. The neutron radiotherapy project in the applications research program is investigating the efficacy of neutrons in the treatment of cancer. A number of measurements have been performed, including neutron dose rate, neutron energy spectra, depth doses for various collimators, oxygen enhancement ratios, and radiobiological effectiveness of this beam using various biological systems. (auth)

24871 (COO-3368-4) REPORT OF THE AD HOC PANEL ON HEAVY ION FACILITIES. (National Academy of Sciences–National Research Council, Washington, D. C. (USA). Committee on Nuclear Science). 1974. 86p. Dep. NTIS $6.50.

In response to a request from the USAEC, the President of the National Academy of Sciences appointed an Ad Hoc Panel under the NAS-NRC Committee on Nuclear Science to make an intensive study of various aspects of the science and technology involved in heavy ion research in light of the needs of the national program in this field. In particular, the panel was asked to formulate and evaluate various options for the development of heavy ion facilities that would include an appropriate accelerator complex capable of producing heavy ion beams and the ancillary apparatus required for experimental exploitation. Also, the Panel was asked to evaluate the current status and potentialities of the Super HILAC and Bevalac accelerators of the Lawrence Radiation Laboratory, Berkeley. Results of the study are presented. Topics include heavy ions in nuclear physics and chemistry, atomic physics, heavy ions and astro and space physics, materials science and solid state, and biomedicine. The state of the technology related to the choice of a heavy ion accelerator system is reviewed, and the various possible choices are reviewed including the large tandem accelerator, tandem–cyclotron systems, and linear accelerators. The upgrading of existing facilities (Super HILAC, Bevalac, and PPA) is discussed. Cost estimates for various heavy ion facilities are briefly discussed. (WHK)

24872 (JPRS-61358) RESEARCH DEVELOPMENT ON THE CREATION OF LINEAR ELECTRON ACCELERATORS IN THE MOSCOW PHYSICAL ENGINEERING INSTITUTE. Val'dner, O. A. Translated from Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 14–22 (1972). 12p. NTIS.

A discussion of the various uses of charged particle accelerators, circular iris waveguides, and high-frequency separators is given. (auth)

Auxiliaries and Components

24873 (AD-766705-8) TANDEM VAN DE GRAAFF ON-LINE DATA ACQUISITION SYSTEM. Jones, H. D. (Ballistic Research Labs., Aberdeen Proving Ground, Md. (USA)). Jul 1973. 61p. (BRL-MR-2307). NTIS $3.50.

A detailed description of the computer-based on-line multiparameter data acquisition system at the Ballistic Research Laboratories tandem Van de Graaff accelerator facility is presented. Complete instructions on the practical use of the hardware, data acquisition program, and data reduction program are included. (auth)

24874 IRRADIATION APPARATUS. Goldie, C. H.; Fernald, R. A. (to United States Atomic Energy Commission). US Patent 3,789,214. 29 Jan 1974. Filed date 21 Jul 1967. 10p.

An apparatus for introducing ionizing radiation into compressed gas insulation systems, such as high-voltage generators or transmission lines to smooth out electrical discontinuities, particularly those caused by foreign particulates that produce high gradients, and to increase the voltage holding capability of the system is described. The apparatus of the invention may also be used to regulate and stabilize the voltage of the system by varying the amount of applied load. A corona discharge device may also be used in conjunction with the invention. (Official Gazette)

24875 SIMPLE METHOD (DOUBLE REFLECTION METHOD) FOR MEASURING THE AVERAGE PROTON ENERGY BY VAVILOV–CHERENKOV RADIATION. Zrelov, V. P. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instrum. Methods; 115: No. 2, 457–459(1974).

A simple method is described for measuring the average energy of relativistic particles by Vavilov–Cherenkov radiation appearing in the trigonal prism-radiator with mirror surfaces. The calculation formulas are presented. The precision of proton-energy measurements achieved by this method has been estimated. (auth)

24876 REGULATOR FOR REDUCING THE EFFECTS OF TERMINAL VOLTAGE FLUCTUATIONS IN TANDEM ACCELERATORS. Roth, G. W.; Weitkamp, W. G. (Univ. of Washington, Seattle). Nucl. Instrum. Methods; 115: No. 2, 501–506(1974).

A regulator which reduces the effects of terminal voltage fluctuations has been constructed and installed in an FN tandem accelerator. An error signal derived from momentum analysis of the accelerator beam is transmitted to the terminal by an optical telemetry channel. The signal modulates a voltage applied to either the gas stripper canal or the foil stripper. The system has typically improved the transmission of the beam through the analyzing magnet by 30%, and has reduced the spread in the beam energy by as much as 30%. (auth)

24877 DIRECT ON-LINE VISUALIZATION SYSTEM FOR A MONOCHROMATIC POSITRON BEAM USING A PDP8/I COMPUTER. Garganne, P.; Daujat, P.; Veyssiere, A. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Instrum. Methods; 115: No. 2, 477–487(1974).

A direct, permanent and quasi-instantaneous visualization system adaptable to charged particle beams without intercepting the beams themselves in any appreciable way is proposed. This procedure uses standard electronic material and permits a continuous display of the average transverse spatial dimensions of the beam on a visualization unit coupled to a PDP8/I computer. Positron beam currents as low as 10^{-14} A have thus been successfully displayed. (auth)

24878 NOVEL H-TYPE STRUCTURE: COMPARISON WITH AN INTERDIGITAL STRUCTURE. Chambert, A.; Voisin, G. (Univ., Lyon). Nucl. Instrum. Methods; 115: No. 2, 471–476(1974). (In French).

It is attempted to compare two kinds of H-type structures. The first one, the interdigital H-type structure, was already studied extensively in Lyon. The second one was proposed at Saclay a long time ago. It seems, following the measurements, that the two structures are quite comparable. (auth)

Ion Sources and Injection and Extraction Systems

24879 (LBL-727) BEVATRON BEAM INJECTION PROGRAMS: INJECT, PHASE, HINJ. Volume I. A User's Guide. Close, E.; Germain, P.; Holley, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 18 Feb 1972. Contract W-7405-eng-48. 109p. Dep. NTIS $7.50.

A general description of the treatment of the Bevatron injection problem is presented, and the programs are described. The program INJECT for the acceptance calculation determines what beam can be accepted into the machine as a coasting beam. The rf trapping calculation, PHASE, tells what beam will be accepted as the rf voltage is turned on. The accepted pulse calculation, HINJ, uses the results of the two previous calculations to determine what fraction of an injected pulse survives the injection, rf trapping process. The appendices contain sample control card checks, input data cases, and selected program output. (WHK)

24880 HE AND Li$^-$ IONS FROM A MODIFIED CHARGE EXCHANGE SOURCE. Philipp, G.; Scheib, U.; Hofmann, A. (Univ., Erlangen, Ger.). Nucl. Instrum. Methods; 115: No. 2, 507-508 (1974).

A HVEC standard source for negative ions has been modified by installing an electrically heated lithium oven. The current intensities of the He$^-$ and Li$^-$ ions, which can be obtained are 4 μA and 1.7 μA, respectively. (auth)

24881 PROCESS FOR MAINTAINING A VAPOR IN AN ISOTHERMAL ENCLOSURE COMMUNICATING WITH AN EVACUATED ENCLOSURE. The Corresponding Apparatus. Bacal, M.; Reichelt, W. (to Commissariat a l'Energie Atomique). French Patent 2,156,432. 19 Oct 1971. (In French).

A process is described for maintaining a vapor in the isothermal hot central part of an elongated tubular enclosure closed at its ends by cold zones and communicating with another enclosure at very low pressure. In this process, the vapor circulating in the isothermal enclosure follows a closed cycle (vapor phase from the hot zone towards the cold zones, liquid phase from the cold zones towards the hot zone, the last part of the cycle resulting from the capillary forces created on the walls of the enclosure). An enclosure of this type utilizing lithium vapor can be used in tandem Van de Graaff accelerators for the charge exchange channel. This accelerator employs negative ions. In order to produce negative He ions, the positive He ions emitted by the ion source are made to traverse the lithium vapor where they pick up electrons. (FR)

24882 INJECTION OPTIMIZATION FOR INCREASING INTENSITY AND STABILITY OF THE BETATRON BREMSSTRAHLUNG. Drozdov, L. N. (Tomsk Polytechnical Inst., USSR). Izv. Tomsk. Politekh. Inst.; 213: 108-110(1972). (In Russian).

The results of the investigation on increasing the intensity of the bremsstrahlung of the B-39 betatron by optimization of the form of the injection pulse are reported. For increasing the stability of the intensity a scheme was proposed for the automatic fine adjustment on the optimum injection phase in conjunction with a variation of the injection voltage. The operation of the channel of injection phase optimization is described. The investigation showed that the intensity of the betatron, operating in the optimum regime, is increased 2 to 3 times. (tr-auth)

Ion Optics and Field Calculations

24883 (FRNC-TH-419) STUDY OF THE CENTER OF THE GRENOBLE CYCLOTRON. Bensahel, D. (Grenoble-1 Univ., 38 (France)). 1973. 134p. (In French). Dep. NTIS (U. S. Sales Only) $8.75.

Thesis.

The isochronous Grenoble cyclotron consists of two 90° sectorial dees to which a high-frequency voltage is applied and two earthed counter-dees. It can be used to accelerate protons, deuterons, alpha particles, and helium ions (singly or doubly charged) to different energies. In the future, this machine will be used to accelerate heavy ions. The purpose of the research carried out was the practical determination of the trajectories at the center of the cyclotron. The distribution of the magnetic field was determined by the C. S. F. Company. The distribution of the electric field was determined using a magnetic analogy on a scale 3 mock-up of the cyclotron. The calculation procedure developed by the I.S.N. at Grenoble was used. The trajectories deviate very little from the meridian plane of the magnetic field because symmetry exists only in the O(z) direction. The trajectories in the median and vertical planes were decoupled. In the case of the determination of the resolution in the median plane, the weak nature of the energies in the central region is taken into consideration and the nonrelativistic approximation is valid. A step-by-step integration was carried out. In the case of the vertical trajectories B_x and B_y cannot be neglected as they are both multiplied by large quantities: v_y and v_x; the equation of motion is integrated using measurements made in the meridian plane. A numerical method capable of being adapted to a computer was developed for determining equipotentials, the method being based on over-relaxation. (FR)

24884 (JINR-P9-7580) SOLUTION OF A LINEAR INVERSE PROBLEM OF MAGNETOSTATICS BY THE REGULARIZATION METHOD. Zhidkov, E. P.; Zinov'eva, L. L.; Rubin, N. B. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. 21p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

A linear inverse problem of magnetostatics is considered, i.e., the determination of the current densities over the given field of a magnetic system with the known geometry. Mathematically the problem is reduced to the linear integral Fredholm equation of the first type which is solved by the regularization method of the zeroth smoothness order. An example is given of solving the problem of the gradient field in an electron-ring accelerator. (auth)

24885 POSSIBLE SCHEMES OF A CYCLIC ACCELERATION OF ELECTRONS WITHOUT RADIATION. Vorob'ev, A. A. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 10, 10-15(1973). (In Russian).

The movement of electrons or positrons in an accelerator along a curved trajectory is accompanied by continuous radiation of electromagnetic energy. The movement of electrons in a central force field of the atomic nuclei is not accompanied by continuous radiation. In atomic systems only quantum radiation, which originated in accelerators with attainment of some parameters, is observed. The physical possibilities of a hydrogen-like nonradiating cyclic accelerator are examined. The cyclic accelerator of a large number of electrons or positrons can be accompanied by the emergence of conditions under which radiation does not occur or it can be compensated by interferrence in the beam volume. Quenching of the radiation occurs during thermodynamic equilibrium in systems of accelerated electrons and their radiation. (tr-auth)

24886 CYCLOTRON WITH AZIMUTHAL VARIATION OF THE ELECTRIC FIELD. ELEMENTARY THEORY. Petrunin, V.I. (D. V. Efremov Scientific-Research Institute of Electrophysical Apparatus, Leningrad). Sov. Phys.-Tech. Phys. 18: No. 4, 491-495 (Oct 1973).

An analysis is made of the acceleration and focusing of particles by an azimuthally varying electric field of a cavity resonator. When the number of acceleration cycles is equal to the number of azimuthal variations continuous particle acceleration can be achieved, the energy increase per orbit can be raised, the high-frequency power loss can be reduced, and the size of the accelerating system can be reduced. The field components are found in the quasistatic approximation and the electrode equations are analyzed in the single-harmonic approximation of the field in the median plane. The coordinate equations of motion are solved for azimuthal and vertical motion. The equations found for the energy increase per orbit and for the frequency of vertical oscillations predict a high acceleration rate and possible separation of orbits in the cyclotron; they also show that it is possible in principle to accelerate and focus particles by means of an electric field alone. An analysis is made of the adiabatic change in the vertical dimensions of the beam under the influence of an electric field. Possible accelerating structures for low- and high-energy cyclotrons are discussed. (auth)

24887 SEPARATED-FUNCTION PERIODIC MAGNETIC STRUCTURE FOR ACCELERATORS. Shukeilo, I.A. (D. V. Efremov Scientific Research Institute of Electrophysical Apparatus). Sov. Phys.-Tech. Phys. 18: No. 2, 284-285 (Aug 1973).

Simple equations are given for the approximate treatment of the characteristics of a separated-function magnetic structure for an accelerator. The parameters of the structure are optimized starting with the minimum aperture condition. The accuracy of the calculations is illustrated by an example. (auth)

24888 LONGITUDINAL STABILITY OF BEAMS IN CYCLICAL ACCELERATORS AND STORAGE RINGS WITH RESONANT SYSTEMS. Grigor'ev, V.P. (Scientific Research Institute of Nuclear Physics, Electronics, and Automation (affiliated with S. M. Kirov Tomsk Polytechnic Institute)). Sov. Phys.-Tech. Phys. 18: No. 3, 397-401 (Sept 1973).

The self-consistent field method is used to investigate the longitudinal stability of a system of identical bunches of finite dimensions interacting with a resonance structure. The growth rates and stability of the beam are determined for all possible modes of oscillation. A study is made of the dependence of the growth rate and the threshold number of particles on the dimensions of the beam, the harmonics of the rotation frequency, the resonator Q, and the detuning $\delta=\omega_r-n\Omega_s$. (auth)

24889 LONGITUDINAL COMPRESSION OF AN ELECTRON RING IN A SLOW ELECTROMAGNETIC WAVE. Bogdanova, S.N.; Gavrilova, Z.G.; Reshetnikova, K.A. (Joint Institute of Nuclear Research, Dubna). Sov. Phys.-Tech. Phys. 18: No. 2, 236-239 (Aug 1973).

A study is made of the possibility of longitudinal compression of an electron ring in an electromagnetic wave that travels symchronously with the ring. It is shown that if the bunching is enhanced by parametric resonance the amplitude of the oscillations in the longitudinal direction is reduced more than under ordinary adiabatic conditions. (auth)

24890 STABILITY OF A SHIELDED ELECTRON RING. Zhabitskii, V.M.; Zolina, I.A.; Kaminskaya, A.M.; Ivanov, I.N.; Perel'shtein, E.A. (Joint Institute of Nuclear Research, Dubna). Sov. Phys.-Tech. Phys. 18: No. 2, 232-235 (Aug 1973).

The stability of an electron ring is studied for the case in which the center is displaced relative to the axis of a shielding tube. The motion of the particles in the displaced ring is analyzed. Restrictions on the admissible deviation of the ring center are obtained as functions of the parameters of the system. (auth)

24891 BEAM TRANSFORMATIONS USING A HELICALLY TWISTED QUADRUPOLE DOUBLET. Youssef, E. A.; Chute, F. S.; Vermeulen, F. E. (Univ. of Alberta, Edmonton). Nucl. Instrum. Methods; 115: No. 2, 489-500(1974).

A solution for particle motion along a twisted electrostatic quadrupole, recently developed by the authors, is extended and applied to a twisted doublet consisting of two identical sections, one twisted clockwise, the other counterclockwise. It is shown that many different beam transformations are possible with this doublet. For example, by proper choice of the system parameters, a point source of particles can be collimated to a parallel beam or conversely a parallel beam can be focused to a point. Selection of parameters is examined in detail for several such transformations. (auth)

24892 PICOSECOND BEAM MONITOR. Schutt, D. W.; Beck, G. O. (to United States Atomic Energy Commission). US Patent 3,784,909. 8 Jan 1974. Filed date 23 Jan 1973. 6p.

The current in the beam of a particle accelerator is monitored with picosecond resolution by causing the beam to impinge upon the center conductor of a coaxial line, generating a pulse of electromagnetic energy in response thereto. This pulse is detected by means such as a sampling oscilloscope. (Official Gazette)

Experimental Facilities

Refer also to abstract 24335.

24893 (BNL-18526) TANDEM VAN DE GRAAFF ACCELERATOR FROM A USER'S POINT OF VIEW. Wegner, H. E. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 28p. (CONF-731214-1). Dep. NTIS $3.50.

From symposium on a joint regional nuclear facility; Montreal, Quebec, Canada (15 Dec 1973).

The BNL three-stage tandem Van de Graaff facility is described. The facility consists of two tandem accelerators in-line. Operation, beam lines, and facilities are discussed. (WHK)

24894 (BNL-18627) CHARACTERISTICS OF MESB: DESCRIPTION FOR USERS. Murphy, C. T.; Fox, J. D. (Brookhaven National Lab., Upton, N. Y. (USA)). 28 Jan 1974. 44p. Dep. NTIS $4.25.

The beam optical design and calculated performance data are presented for the Medium Energy Separated Beam from the "B" target station. Various modes of operation which enable the beam to separate kaons to 6 GeV/c, and anti-protons to 9 GeV/c are discussed. Purified particle fluxes in excess of 10^5 K^+, 5×10^4 K^-, and 10^5 $\bar{p}$ per 10^{12} protons interacting in a beryllium target are anticipated. (auth)

24895 (FRNC-TH-436) STUDY AND DEVELOPMENT OF THE GRENOBLE 0.9 GeV/c MAGNETIC SPECTROMETER: THE MULTIPOLE SPECTROMETER CHANNELS. Roux, B. (Grenoble-1 Univ., 38 (France)). 1973. 84p. (In French). Dep. NTIS (U. S. Sales Only) $6.25.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

The 0.9 GeV/c magnetic spectrometer developed at Grenoble (work began in 1971), should become operational in September 1973. The high performance required of this spectrometer necessitates that all the adjustable parameters are set to their optimum values. In the spectrometer channel these parameters concern: dipole excitation, quadrupole excitation, the existence of sextupoles, and the positions of the two detectors. It is difficult to envisage a manual optimization of all these adjustments by a trial and error method. An optimization program is thus necessary. The assembly can be arranged in such a way as to eliminate measurements of the real magnetic field in the spectrometer channel multipoles. It is sufficient to construct theoretical maps for these elements; in contrast, every effort should be made to obtain accurate maps for the field in the dipole. (FR)

24896 (GEPP-124) PENNING GAGE TEST TO MEASURE INTERNAL PRESSURE IN A NEUTRON TUBE. Sturtz, J. P. (General Electric Co., St. Petersburg, Fla. (USA). Neutron Devices Dept.). 4 Mar 1974. Contract AT(29-2)-656. 12p. Dep. NTIS $3.00.

A neutron generator tube can be operated in a Penning gage mode to determine the internal gas pressure of the tube. Pressures as low as 2×10^{-6} torr of helium-3, 3×10^{-7} torr of argon, and 2×10^{-7} torr of CO_2 have been measured in a neutron tube at General Electric Neutron Devices Department (GEND). This technique permits a simple test for detecting vacuum wall leaks as low as 1.2×10^{-13} std. c/sec., which is two orders of magnitude greater sensitivity than the present residual gas analyzer technique. (auth)

24897 (KFK-1857) CAPABILITIES FOR THE STUDY OF FAST NEUTRON INTERACTIONS OF THE ISOCHRONOUS CYCLOTRON TIME-OF-FLIGHT SPECTROMETER. Cierjacks, S. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). May 1973. 27p. (CONF-730538-6). Dep. NTIS (U. S. Sales Only) $3.50.

From National Soviet conference on neutron physics; Kiev, USSR (28 May 1973).

The capability of neutron time-of-flight spectrometry in conjunction with an isochronous cyclotron is discussed on the basis of the Karlsruhe facility. Present specifications of this spectrometer are given to demonstrate its ability for the study of all important neutron interactions in the energy range from several hundred keV to 30 MeV. The increasing importance of fast neutron data for several applied nuclear energy programs is pointed out. In the area of total and partial cross section measurements typical examples of new high resolution data are shown. Accompanying neutron physics work is briefly summarized. (GE)

24898 NT-20 PIPE NEUTRON GENERATOR. Evdokimov, A. V.; Kadushev, V. B. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 22, 117-120(1973). (In Russian).

A laboratory model of a NT-20 pipe neutron generator for neutron activation analysis is described. The construction characteristics and the electrical circuits are reported. (tr-auth)

24899 HIGH RESOLUTION PHOTON TAGGING SYSTEM IN THE GeV REGION. Brookes, G. R. (Univ. of Sheffield, Eng.); Gabathuler, E.; Rawlinson, W. R.; Shiel, C.; Tolfrée, W. D. L. Nucl. Instrum. Methods; 115: No. 2, 465-469(1974).

A photon tagging system which measures the energy of photons in a bremsstrahlung spectrum is described. The apparatus covers a photon energy range of 2 GeV starting 160 MeV below the energy of the incident electron beam. 192 counters provide a nominal resolution between 6 MeV for a photon energy 160 MeV below the incident electron energy and 11 MeV for a photon energy 2160 MeV below the incident electron energy. (auth)

24900 ANNIHILATION PHOTON BEAM WITH ANGULAR DISCRIMINATION. Blum, D.; Boucrot, J.; Grossetete, B.; McGill, W.; Nguyen Ngoc, H. (Univ. Paris, Orsay, France). Nucl. Instrum. Methods; 115: No. 2, 553-562(1974).

A monochromatic photon beam with peak energy in the range 250 to 500 MeV and a constant fwhm energy resolution of about 0.07 is described. The photons come from annihilation in flight of positrons in a HLi target. They are collected in a very small solid angle at a relatively large mean angle. The prediction of the beam as well as the calculations of the photon energy spectrum are discussed. The calculations are then compared to measurements of photoproduction on deuterium and photoproduction on hydrogen made with multiwire proportional chambers in a magnetic spectrometer. (auth)

24901 BETATRON STEREOGRAPHY. Braslavskii, G. D.; Gorbunov, V. I. (Tomsk Polytechnical Inst., USSR). Izv. Tomsk. Politekh. Inst.; 213: 93-98(1972). (In Russian).

The possibility of the detection of defects and the determination of their depth and dimensions by means of a nondestructive control method using a betatron as a radiation source was examined. The possibility of determining the location and dimensions of the defects by stereograms using a two-beam betatron is shown. The method for obtaining the stereographic photographs from one or two exposures is described. Expressions are derived for the determination of the sensitivity of this method of defect control and the results of the determination of the time costs are reported. (tr-auth)

24902 EFFICIENCY OF USING BETATRONS FOR FLAW DETECTION. Berdonosov, V. A.; Vorob'ev, V. A.; Gorbunov, V. I. (Tomsk Polytechnical Inst., USSR). Izv. Tomsk. Politekh. Inst.; 213: 49-52(1972). (In Russian).

The investigation of the efficiency of the use of betatrons as radiation sources for radiation defectoscopy is described. As a basis of evaluation the following basic indicators were used: sensitivity, control efficiency, and costs. The degree of mechanization and automation of the control process, weight, overall dimensions, construction of the betatron and defectoscope, operational reliability, and maintenance simplicity, and control characteristics are also considered. The control efficiency was determined by the ratio of the controlled area to the total radioscopy time. On the basis of the analysis of the data on the sensitivity and control efficiency and also the cost of the radioscopy, the overall dimensions and weight of the betatron, reliability, and simplicity of maintenance the following betatrons were recommended for radioscopy: betatrons with maximum bremsstrahlung energy of 9 MeV for steel thickness of 70 to 160 mm, 15 MeV for 100 to 130 mm thickness, and 25 MeV for 120 to 220 mm thickness. An evaluation of the efficiency was made for the control of flat articles and for welded seams. (tr-auth)

24903 EFFICIENCY EVALUATION OF THE USE OF BETATRONS FOR NONDESTRUCTIVE CONTROL OF ARTICLES OUT OF VARIOUS MATERIALS. Berdonosov, V. A.; Vorob'ev, V. A.; Gorbunov, V. I.; Pokrovskii, A. V. (Tomsk Polytechnical Inst., USSR). Izv. Tomsk. Politekh. Inst.; 213: 3-17(1972). (In Russian).

On the basis of the criteria of sensitivity, performance, and cost, the efficiency of the use of radiometric systems of betatrons for crack detection using scintillation counters as radiation detectors was examined. The analysis was made on three materials used industrially (steel, aluminum, and lead) for betatrons with maximum radiation energy of 15, 25, and 30 MeV. The calculations were made for sensitivities of 1.0 and 2.0. The performance was calculated as a function of the thickness of the material. A comparative analysis was made of the performance and cost of the radiometric and radiographic control methods. The comparison showed the advisability of the transition in crack detection to radiometric methods and the efficiency of the use of 25 and 30 MeV betatrons. (tr-auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

24904 DIFFERENCE METHODS FOR TIME-DEPENDENT TWO-DIMENSIONAL CONVECTION. Moore, D. R.; Peckover, R. S.; Weiss, N. O. (Univ. of Cambridge, Eng.). Comput. Phys. Commun.; 6: No. 5, 198-220(Nov 1973).

Some new finite difference methods are developed for investigating a variety of two-dimensional problems in a Boussinesq fluid contained in a rectangular region with free boundaries. The equations are solved on a staggered mesh, thereby halving the requirements for storage and computing time. The temperature and vorticity are governed by parabolic equations, which are solved using leapfrog and Dufort–Frankel schemes. The stream function is related to the vorticity by Poisson's equation, which is solved on the staggered mesh by Fourier analysis followed by diagonal elimination or cyclic recursion; the necessary values are then found by higher order interpolation. Three consistent methods are described: second order schemes on square and on rectangular meshes and a fourth order scheme. Their accuracies are analyzed and applications to a number of convection problems are discussed. (auth)

Cosmic Radiation

Refer also to abstracts 25105 and 25297.

24905 (AD-764833-0) INTERACTIONS OF VERY ENERGETIC CHARGED PARTICLES WITH MATTER. Final Report, 18 January 1972–16 January 1973. McNulty, P. J. (Clarkson Coll. of Tech., Potsdam, N. Y. (USA). Dept. of Physics). 16 Apr 1973. Contract F19628-72-C-0209. 30p. (AFCRL-TR-73-143). NTIS $3.00.

The work carried out involved investigations directed toward increasing our understanding of the high Z cosmic ray nuclei that arrive at the top of the earth's atmosphere. Reported on are experiments involving nuclear interactions of high energy neon nuclei in emulsion, particle induced visual sensations and the ability of the Princeton Particle Accelerator to accelerate argon nuclei to relativistic velocities. (auth) (GRA)

24906 COSMIC-RAY SPECTRAL MODULATION ABOVE 2 GV DURING THE DESCENDING PHASE OF SOLAR CYCLE NO. 19. V. The Influence on the Coupling Functions of the Nucleonic Component. Bachelet, F.; Iucci, N.; Parisi, M.; Villoresi, G. (CNR, Frascati, Italy). Nuovo Cim.; 18B: No. 2, 258-264(11 Dec 1973).

The coupling functions of the nucleonic component of cosmic rays at sea level and at ~1900m a.s.l. are computed for different modulation levels in solar cycle No. 19. The coupling functions are given for the first time with a high degree of accuracy because of the good knowledge of the sea-level latitude effect of the nucleonic component at any wanted time and of the variations of the attenuation coefficient with latitude, altitude, and solar cycle. (auth)

24907 GEOMAGNETIC EFFECTS ON THE ANGULAR DISTRIBUTION OF CHERENKOV LIGHT FROM EXTENSIVE AIR SHOWERS. Porter, N. A. (University Coll., Dublin). Lett. Nuovo Cim.; 8: No. 8, 481-484(20 Oct 1973).

An attempt is made to estimate the magnitude of the magnetic effect, by using a very simplified model of an electron–proton shower. A primary γ ray interacts at a depth of 1 radiation length (37.7 g/cm^2) producing an electron–positron pair. These undergo bremsstrahlung after a further radiation length, and the γ rays produced initiate further electron pairs one radiation length later. The magnetic deflection angle in each radiation length is calculated from the expression $E = 300\ H_\rho$, where E is energy in eV, H is the field in G, and ρ is the radius of curvature in cm. (WDM)

24908 INVESTIGATION OF COSMIC RADIATION IN THE STRATOSPHERE. Charakhch'yan, A. N.; Charakhch'yan, T. N. Tr. Fiz. Inst., Akad. Nauk SSSR; 64: 3-48(1973). (In Russian).

The results of the study of the intensity and energy spectra of different components of cosmic radiation in the Earth's atmosphere and the primary cosmic radiation near the boundary of the Earth's atmosphere are reported. The 11-year solar modulations of the galactic cosmic radiation in interplanetary space are studied, based on experimental results obtained during the 1957 International Geophysical Year. (JSR)

24909 ENERGY SPECTRUM AND COMPOSITION OF THE PRIMARY COSMIC RADIATION AT ENERGIES ABOVE 10^{13} eV. Nesterova, N. M.; Nikol'skii, A. I. Tr. Fiz. Inst., Akad. Nauk SSSR; 64: 49-58(1973). (In Russian).

The results of experimental studies on the energy spectrum and composition of primary cosmic radiation are summarized. It is concluded that on the basis of the available experimental data and its comparison with calculated data it is probable that the energy spectrum of cosmic radiation has the index $\gamma = 1.65$ at $E_0 = 5 \times 10^{13}$ eV/N and $\gamma = 2.1$ to 2.2 at $E_0 = 10^{17}$ eV/N. It is possible that the chemical composition of the primary cosmic radiation changes with respect to the change of the primary spectrum. (JSR)

24910 SPALLATION OF NUCLEI BY HIGH ENERGY PROTONS WITH FORMATION OF MULTICHARGED PARTICLES. Milovanov, V. P. Tr. Fiz. Inst., Akad. Nauk SSSR; 64: 59-99 (1973). (In Russian).

The experimental methods for the study of spallation reactions induced by high-energy protons and the principal results obtained from them are reviewed. The methods used for the interpretation of the experimental results are discussed. (JSR)

24911 ENERGY-DEPENDENT CONFINEMENT MODEL FOR GALACTIC COSMIC RAYS. Holmes, J. A. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc.; 166: No. 1, 155-163(Jan 1974).

Recent observations of cosmic-ray composition suggest that the average path length decreases with energy. A confinement model is proposed to explain this, based on the scattering of cosmic rays by hydromagnetic waves in regions outside the plane of the Galaxy where the density of neutral matter is low enough to allow the waves to form. The effect of this confinement model on the spectrum of cosmic-ray electrons is investigated. (auth)

24912 CONTINUOUS MEASUREMENT OF THE COSMIC-RAY INTENSITY. 2. Measurement of Neutron Component. Ishida, Y.; Kanno, T. (Fukushima Univ., Japan). Fujushima Daigaku Kyoikugakubu Rika Hokoku; No. 21, 1-8(Nov 1971). (In Japanese).

At Fukushime University, the cosmic-ray meson component measurement was made, with a G–M counter, during the last few years. A new type of cosmic-ray meter, IQSY-type neutron monitor, was developed by Carmichael. In August 1971, the IQSY-type neutron monitor consisting of three counters (3-NM-64) was installed at Fukushima University (140°29′E geographic longitude, 37°45′N geographic latitude, 27.6°N geomagnetic latitude). This report describes the outline of neutron monitor and the atmospheric effect of neutron intensity. The counting rate of the neutron monitor is no more than 70% of expected value. The pressure coefficient, β, of the neutron component intensity was estimated to be –0.62%/mb from data at present. (auth)

24913 CORRELATION LENGTH FOR INTERPLANETARY MAGNETIC FIELD FLUCTUATIONS. Fisk, L. A. (Goddard Space Flight Center, Greenbelt, MD); Sari, J. W. J. Geophys. Res.; 78: No. 28, 6729-6736(1 Oct 1973).

It is argued that it is necessary to consider two correlation lengths for interplanetary magnetic field fluctuations. For particles with gyroradii large enough to encounter and be scattered by large-scale tangential discontinuities in the field (particles with energies of $\gtrsim$ several GeV/N) the appropriate correlation length is simply the mean spatial separation between the discontinuities $L \simeq 2 \times 10^{11}$ cm. Particles with gyroradii much less than this mean separation (energies of $\lesssim 100$ MeV/N) appear to be unaffected by the discontinuities and respond only to smaller-scale field fluctuations. For these particles the correlation length is shown to be $L \simeq 2 \times 10^{10}$ cm. With this system of two correlation lengths the cosmic-ray diffusion tensor may be altered from what was predicted by, for example, Jokipii and Coleman, and the objections raised recently by Klimas and Sandri to the diffusion analysis of Jokipii may apply only at relatively low energies (~ 50 MeV/N). (auth)

24914 CALCULATION OF THE COUPLING COEFFICIENTS OF DIFFERENT COMPONENTS OF COSMIC RADIATION IN THE INTERVAL FROM 2 TO 15 GeV. Boos, E. G.; Kolomeets, E. V.; Kupchishin, A. I. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 1-6(1973). (In Russian).

The partial coupling coefficients were determined in the interval from 2 to 15 GeV as a function of the intensity of the secondary cosmic particles from the hardness of the geomagnetic cutoff. Two extreme cases of the energy distribution between nucleons during fragmentation of the original nucleus were examined. (tr-auth)

24915 COUPLING COEFFICIENT OF THE NEUTRON COMPONENT OF COSMIC RADIATION AT SEA LEVEL AND AT

DEPTHS OF 843 g/cm^2 IN THE ATMOSPHERE. Baskakov, V. V.; Boos, E. G.; Kolomeets, E. V.; Kupchishin, A. I. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 85-88(1973). (In Russian).

The basic variation equation was derived with consideration of the nuclear component of primary cosmic radiation. The integral multiplicity and coupling coefficients of the neutron component of cosmic radiation were calculated for minimum and maximum solar activity. (tr-auth)

Stars

Refer also to abstracts 24242, 25009, 25217, 25662, and 25677.

24916 (AD-766407-1) SOME EFFECTS OF DELAYED-NEUTRON EMISSION OF R-PROCESS ABUNDANCES. Report for January–April 1973. Blake, J. B.; Schramm, D. N. (Aerospace Corp., El Segundo, Calif. (USA)). 28 Sep 1973. Contract FO4701-73-C-0074. 23p. (SAMSO-TR-73-255). NTIS $2.75.

Some effects on elemental abundances resulting from delayed-neutron emission during the beta decay back to the valley of stability from the r-process nucleosynthetic path are examined. It is found that delayed-neutron emission results in a skewing of the r-process abundance peaks, with a more rapid falloff on the high mass side and a broader low mass side than would otherwise occur. The location of the maximum is essentially unchanged but the peak is flattened. Skewed peaks are indeed observed in the empirical r-process abundances. Furthermore the reduced odd–even abundance variations observed in the r-process peaks can be due, at least in part, to the smoothing effect of delayed-neutron emission. Delayed-neutron emission does not result in an abundance hump in the rare-earth region. (auth)

24917 (COO-3001-56) CORRELATION EFFECTS IN PION CONDENSATES. Weise, W.; Brown, G. E. (State Univ. of New York, Stony Brook (USA). Dept. of Physics). 10 Jan 1974. Contract AT(11-1)-3001. 15p. Dep. NTIS $3.00.

The threshold for pion condensation in neutron star matter is estimated on the basis of a sufficiently realistic treatment of effective forces. It turns out that the short range repulsion of the nucleon–nucleon force does not permit a pion condensed phase below about twice the density of normal nuclear matter. (auth)

24918 OBSERVATIONS OF THE INFRARED EXTINCTION OF IRS 5 IN W3 COMPARED WITH THE GALACTIC CENTER AND THE BECKLIN–NEUGEBAUER OBJECT. Aitken, D. K.; Jones, B. (University Coll., London). Astrophys. J.; 184: No. 1, 127-133(15 Aug 1973).

Observations of the 8 to 13 μ spectrum of IRS 5 in W3 are presented, indicating that it is a luminous object suffering a large extinction by an extended dust cloud. The cool source in W3, which has been observed at 100 μ, is probably associated with this obscuring cloud. When comparison is made with similar spectra of the Becklin–Neugebauer object in Orion and the galactic center, IRS 5 appears to be an extremely compact dust cloud optically thick at 10 μ and of high luminosity, probably containing a massive protostar. Evidence is also presented indicating that the 10-μ emission from the galactic center and the Becklin–Neugebauer object is thermal radiation from optically thin dust of the same composition as that obscuring all these sources. (auth)

24919 INFRARED POLARIMETRY OF VERY YOUNG OBJECTS INCLUDING THE BECKLIN–NEUGEBAUER SOURCE. Breger, M. (Univ. of Texas, Austin); Hardorp, J. Astrophys. J.; 183: No. 2, L77–L79(15 Jul 1973).

The Becklin-Neugebauer source in Orion shows 25 ± 3 percent linear polarization at 1.6 microns. An upper limit of 3 times the average interstellar value is derived for the size of the aligned dust particles likely to be responsible for the polarization. NU Orionis is polarized in the infrared and visible regions with a significant rotation of position angles. The position angle and wavelength dependence of polarization suggest that the optical polarization arises from aligned intracluster dust particles in front of the object while the infrared polarization may be due to a circumstellar shell. (auth)

24920 SBORNIK ZADACH PO NEBESNOI MEKHANIKE I KOSMODINAMIKE. (Collection of Problems in Celestial Mechanics and Cosmodynamics). Balk, M. B.; Demin, V. G.; Gunitsyn, A. L. Moscow; Izdatel'stvo Nauka Glavnaya Redaktsiya Fiziko–Matematicheskoi Lietratury (1972). 336p.

A book on celestial mechanics and the theory of the movement of cosmic bodies is presented. Both traditional questions on the theory of the movement of natural celestial bodies and engineering problems of astronautics are included. The theory of gravitation, theory of undisturbed Keppler movement, problems of several bodies (both limiting and non-limiting), theory of perturbed motion of artificial and natural celestial objects, qualitative methods for the study of movement, and rocket dynamics and controlled movements are considered. (tr-auth)

24921 FREE–FREE TRANSITIONS OF Cl$^-$. John, T. L.; Morgan, D. J.; Davies, D. (University Coll. of South Wales and Monmouthshire, Cardiff). Mon. Notic. Roy. Astron. Soc.; 166: No. 1, 9P–10P(Jan 1974).

The abundance and possible role of negative chlorine ions as a source of continuous absorption in late type stars has been discussed. The free–free continuous absorption coefficient of Cl$^-$ is determined with wave functions calculated in the close coupling approximation neglecting exchange. The cross section is shown to be an order of magnitude larger than the corresponding results for H$^-$, He$^-$, and C$^-$. (auth)

24922 FORMATION OF DUST IN COOL STARS. Bychkova, V.S. Sov. Astron.–AJ 17: No. 2, 274-276 (Sept 1973).

The present article examines some problems connected with the formation of graphite dust in long period variables during the time of their minimum brightness. The concentration of dust particles that can grow over the photosphere to a standard size $r=5.10^{-6}$ cm is estimated. This concentration is comparable to that of metal ions, so that these ions may be the nucleation centers. The optical thickness may be considerable. Then the temperature rises and the formation of dust in these layers ceases. Radiation pressure is estimated. The dust may be partially responsible for the proper polarization of the light of these stars. A field of up to 100 G can produce particle orientation only in the upper layers with a concentration of less than 10^{13} cm^{-3}. For the orientation it is necessary that the temperature of the gas be considerably higher than that of the particles. This requires the existence of a hot chromosphere. The field does not impede the diffusion of charged dust particles through the upper layers of the chromosphere. (auth)

24923 STELLAR EVOLUTION DURING THE GROWTH PHASE OF THE CARBON–OXYGEN CORE. Uus, U. (Astronomical Council, Academy of Sciences of the USSR). Sov. Astron.–AJ 17: No. 2, 196-200 (Sept 1973).

A simple method is described for calculating stellar models with dense isothermal cores and thin nuclear-burning shells. Results are presented for the evolution of stars of masses 1.5, 2, 3, and 5 $M_\odot$ and with an envelope of chemical compositions $X=0.70$, $Z=0.04$ during the period when the C—N core grows from a mass $M_c \simeq 1.4\ M_\odot$. The evolution of the core is practically independent of the mass of the star. The C and O distribution in a core growing by shell burning is determined. The thermal stability of the shell burning will be governed mainly by the type of nuclear reaction. The calculated structure of red-supergiant envelopes is found to be sensitive to the version of the theory adopted for convective heat transfer. A hydrogen star might be converted into a helium star if the convective region of its envelope penetrates into the zone of nuclear hydrogen burning. (auth)

24924 COOLING TIME AND INTERNAL PROPERTIES OF HOT WHITE DWARFS. Vartanyan, Y.L.; Adzhyan, G.S.; Arutyunyan, A.S. (Byurakan Astrophysical Observatory). Sov. Astron.–AJ 17: No. 2, 201-204 (Sept 1973).

The internal structure and cooling time are determined for three model configurations of hot white dwarfs (mass $M/M_\odot = 0.182, 0.727, 1.082$), whose thermonuclear-energy supply has been exhausted. The internal temperature distribution is established for various values of surface temperature. A substantial temperature gradient persists into the outer portion of the core, where the material consists of degenerate electrons and atomic nuclei. In the general case the internal thermal energy of hot white dwarfs comes not only from the atomic nuclei but also from the quasidegenerate electron gas. The cooling time from one value of the surface temperature to another is calculated, allowing for the neutrino luminosity. The results are presented graphically and in tabular form. (auth)

24925 MODEL FOR THE OBSERVED POLARIZED FLUX FOR ZETA TAURI. Capps, R. W. (Kitt Peak National Observatory, Tucson, AR); Coyne, G. V.; Dyck, H. M. Astrophys. J.; 184: No. 1, 173-179(15 Aug 1973).

New optical and infrared observations of ζ Tau is presented. A model is proposed to explain the observed wavelength dependence of the polarization, and is fitted to the polarimetric observations extending from 0.3 to 2.2 μ. In addition to emission from a hydrogen recombination spectrum in a flattened disk about the star, free–free emission in the disk is also required in order to explain the observed polarization in ζ Tau from the Paschen limit to 2.2 μ. (auth)

24926 SUPERGIANT BINARIES IN THE H AND CHI PERSEI ASSOCIATION. Abt, H. A.; Levy, S. G. (Kitt Peak National

Observatory, Tucson). Astrophys. J.; 184: No. 1, 167-172(15 Aug 1973).

A study of 23 B0-A5 supergiants in Per OB1 showed the existence of three spectroscopic binaries for which orbital elements are derived and three possible additional binaries. The resultant binary frequency of at least 15 percent is similar to that of field supergiants and Cepheids. No binaries with periods less than 32 days in length were found, implying that the known supergiant x-ray sources of much shorter periods are probably rarely found systems. (auth)

24927 ELEMENTARY-PARTICLE EFFECTIVE MASSES IN SUPERDENSE MATTER. Bowers, R. L. (Univ. of Texas, Austin); Zimmerman, R. L. Astrophys. J.; 184: No. 1, 305-309(15 Aug 1973).

The relativistic effective mass of a nucleon in a degenerate nucleon sea is presented. The calculation is based on a fully relativistic many-body theory for strongly interacting matter in its ground state. Interactions resulting from the exchange of pseudoscalar mesons are included to second order in the coupling constant. In the asymptotic limit ($\hbar q_F/mc \gg 1$) the effective nucleon mass is shown to be $m_{eff} \sim (4/3)\hbar q_F/c - (5/2)m$, where the nucleon physical mass is m, and q_F is the Fermi wave vector. The significance of this mass shift in terms of its effect on particle number densities and thresholds is discussed in the asymptotic limit of high densities for a system of nucleons, electrons, and pions. (auth)

24928 STELLAR FLUX CALIBRATION AT 10 AND 20 μ USING MARINER 6, 7, AND 9 RESULTS. Becklin, E. E. (California Inst. of Tech., Pasadena); Hansen, O.; Kieffer, H.; Neugebauer, G. Astron. J.; 78: No. 10, 1063-1066(Dec 1973).

The stellar flux calibrations at 10 and 20 μ were obtained by comparing observations of α Orionis and α Scorpii with observations of the central area of Mars. The flux from Mars, in turn, was inferred from data of the Mariner 6, 7, and 9 infrared radiometers. If the 10- and 20-μ broadband magnitudes of α Ori are set equal to -5.18 and -5.70, the flux of a zero magnitude star was determined to be $1.3 \pm 0.2 \times 10^{-16}$ and $8.1 \pm 1.5 \times 10^{-18}$ W cm^{-2} μ^{-1} at 10.0 and 20.0 μ. (auth)

24929 SPACE DISTRIBUTION OF THE O STARS IN THE SOLAR NEIGHBORHOOD. Walborn, N. R. (Univ. of Toronto, Richmond Hill, Ont.). Astron. J.; 78: No. 10, 1067-1073(Dec 1973).

New results pertaining to the two-dimensional spectral classification system for the O stars are presented. Classifications for additional stars in both hemispheres are given, and two groups of peculiar Of-like spectra are described and illustrated. Some refinements of the absolute-magnitude calibration are discussed. The space distribution projected into the galactic plane is derived for all nonpeculiar O stars with classifications. The most striking result is the clear separation of the Carina–Sagittarius arm from the local arm along the entire longitude range of 285 to 20°. The good agreement with previous results for other types of young objects provides evidence in support of the new luminosity classification for the O stars. (auth)

24930 MASS RATIO OF L726-8. Harrington, R. S.; Behall, A. L. (Naval Observatory, Washington, DC). Astron. J.; 78: No. 10, 1096-1098(Dec 1973).

A solution combining photographic positions of both components, as well as of the blended images during the period of nonresolution, yields a parallax for L726-8 of $0.381 \pm 0.005''$(m.e.) and a mass ratio of 0.487 ± 0.011. Using a new visual orbit by Worley and Behall (1973), the individual masses are computed to be $0.115 \pm 0.008M_\odot$ and $0.109 \pm 0.008M_\odot$. (auth)

24931 PARALLAX AND MASS RATIO OF THE VISUAL BINARY 61 CYGNI. van de Kamp, P. (Swarthmore Coll., PA). Astron. J.; 78: No. 10, 1099-1103(Dec 1973).

Measurements of 966 plates on 61 Cygni taken with the Sproul 24-in. refractor on 280 nights over the interval 1912–1972, gives values of $+0.2828 \pm 0.0013''$ (p.e.) and $+0.2884 \pm 0.0016''$ for the relative parallaxes of the A and B component respectively. An analysis of the quadratic time effects in the paths of A and B yield a fractional mass of 0.50 ± 0.02, corresponding to a mass of $0.60M_\odot$ for each component. Several more decades of observation are needed to lead to a substantial improvement in the accuracy of the mass ratio. (auth)

24932 ANALYSIS OF THE PERTURBATIONS ON BARNARDT'S STAR. Jensen, O. G.; Ulrych, T. (Univ. of British Columbia, Vancouver). Astron. J.; 78: No. 10, 1104-1114(Dec 1973).

A Maximum Entropy Method spectral analysis of van de Kamp's data on the perturbation motions of Barnard's Star suggests that several planets may be in orbit about it. The preferred interpretation requires planets with 26-, 11-, 3.8-, 2.9-, and 2.4-year orbital periods having masses ranging from 0.7 to 1.6 times the mass of Jupiter. The interpretation is based upon probability and likelihood arguments. (auth)

24933 PHOTOGRAPHIC SURFACE PHOTOMETRY OF THE NUBULAE SURROUNDING V380 ORI AND R MON. Brueck, M. T. (Royal Observatory, Edinburgh). Mon. Notic. Roy. Astron. Soc.; 166: No. 1, 123-154(Jan 1974).

The results presented here are the first in an extensive programme of multi-colour photographic surface photometry of peculiar nebulosities surrounding young stars which is made possible by the use of the galaxy plate measuring machine. The method of producing brightness and colour maps which are calibrated by in-focus stellar images recorded by Galaxy's incremental scan facility is described. The present observations of the nebulosities surrounding V380 Ori and R Mon in U B V H_α and I show that both nebulae are biuer than the stars and that NGC 2261 surrounding R Mon has a distinct colour pattern. (auth)

24934 CNO ABUNDANCIES OF THE CH STARS IN ω Centauri. Bell, R. A.; Dickens, R. J. (Univ. of Maryland, College Park). Mon. Notic. Roy. Astron. Soc.; 166: No. 1, 89-99(Jan 1974).

The Swan bands in the spectra of the ω Cen CH stars RGO 55 and RGO 70 have been analyzed, using synthetic spectra calculations, and yield $C^{12}/C^{13} \sim 10$ and $[C/H] \sim -0.8$, the latter abundance being obtained under the assumption that $[O/H] = -1.3$. The nitrogen abundance, [N/H], obtained from bands of the blue and red CN systems, is approximately solar for both of the stars. The UBV colours of the CH star models show ultraviolet excesses of ~0.3 mag when compared with normal giant models, in agreement with photometry of the cluster stars. The models also show that the fact that the CH stars are grouped with the red variables in the cluster c–m diagram is caused by the reddening effects of the carbon features on B–V. The weak appearance of the Ca I 4226 line in CH star spectra is shown to be caused to a large extent by the great strength of the CH and CN features. (auth)

24935 EMISSION-LINE VARIABILITY IN QUIESCENT FLARE STARS. Bopp, B. W. (Univ. of Texas, Austin). Mon. Notic. Roy. Astron. Soc.; 166: No. 1, 79-87(Jan 1974).

Spectroscopic monitoring of five flare stars (UV Ceti, YZ CMi, BY Dra, YY Gem, and BD + 48° 1958A) reveals that the stars exhibit marked decreases in the Balmer and Ca II emission line strengths over intervals of one day or less. The variations can be explained by a nonuniform, patchy distribution of emitting regions on a rotating star. This is consistent with the starspot model from which in some other cases stellar rotation periods were inferred. Equatorial rotational velocities inferred are significantly greater than might be expected for ordinary stars at the same positions in the H–R diagram. (auth)

24936 RADIATIVE TRANSFER IN SPHERICALLY SYMMETRIC SYSTEMS. IV. Solution of the Line Transfer Problem With Radial Velocity Fields. Kanasz, P. B.; Hummer, D. G. (Univ. of Colorado, Boulder). Mon. Notic. Roy. Astron. Soc.; 166: No. 1, 57-58(Jan 1974).

A numerical procedure is presented for solving the line transfer problem with complete redistribution in spherically symmetric atmospheres in which the radial velocity is an arbitrary function of radius, limited by practical considerations to maximum velocities a few times the mean thermal velocity. In this procedure the transfer equation, written in the observer's frame, is differenced along rays and the resulting very large set of coupled linear equations is cast into the novel form, proposed by Rybicki, that allows for extremely rapid solution of the system. Numerical results are discussed for three sequences of models, two with linear velocity laws and one with constant velocities, in which the effect of the transverse velocity gradient is demonstrated. It is shown that velocities as small as 0.05 of the mean thermal velocity produce observable asymmetries in the flux profile. (auth)

24937 RADIATIVE TRANSFER IN SPHERICALLY SYMMETRIC SYSTEMS. III. Fundamentals of Line Formation. Kanasz, P. B.; Hummer, D. G. (Univ. of Colorado, Boulder). Mon. Notic. Roy. Astron. Soc.; 166: No. 1, 19-55(Jan 1974).

A generalization of the variable Eddington factor method is presented that makes possible the solution of line formation problems in extended spherical atmospheres whose constitutive properties depend on radius in an arbitrary way. Extensive numerical results for Doppler broadening in models with power law opacities ($n = 0, 2, 3$) are presented and interpreted. Very substantial deviations are found from the solutions of analogous plane-parallel models. The single-flight escape probability is derived for a general opacity law and is shown to exceed that for an analogous plane-parallel slab by no more than a factor of approximately two for Doppler broadening, or three-halves for Lorentz broadening. However, it is shown that each time a photon is scattered, it has a probability greater than one-half of ending its flight at a radius larger than that at which it was emitted. This effect is peculiar to spherical geometries and may be important in aiding the escape of photons from optically thick systems. Finally the effects of dilution are considered and some properties of the infinite radius, finite optical depth models are inferred. An appendix contains the solution of the line transfer problem for a homogeneous sphere by the kernel-approximation method. (auth)

24938 INTRINSIC LINEAR POLARIZATION OF 53 CAMELOPARDALIS AND α^2 CANUM VENATICORUM. Kemp, J. C.; Wolstencroft, R. D. (Univ. of Hawaii, Honolulu). Mon. Notic. Roy. Astron. Soc.; 166: No. 1, 1-18(Jan 1974).

The intrinsic phase-dependent linear polarization of the magnetic Ap stars 53 Cam and α^2 CVn has been studied. The polarization of 53 Cam in a broad blue filter band centered at λ 4700, width 1400 Å, shows a clear correlation with the magnetic and light-curve phases, and has the following features: (1) The position vector rotates clockwise to an observer facing the star, revolving by 360° over one magnetic period; this is understood to be the actual sense of rotation of the star as projected on the sky. (2) The average degree of polarization p is about 4×10^{-4} in the blue band. (3) In a broad yellow-red band the polarization has only a small variation about a constant component $p_O = 2 \times 10^{-4}$, $\theta_O = 172°$, which, it is supposed, is interstellar. (4) Data for the ultraviolet indicate a larger variable polarization than in the blue. (5) In Hβ, using a filter 15-Å wide, a variable polarization of mean amplitude $p = 10 \times 10^{-4}$ is found; the precise behavior is not clear, though some similarity to the blue-band phase curves is seen. In α^2 CVn, the broad-band polarization is negligible ($p \leq 1 \times 10^{-4}$) in the visible at all phases. There is a variable effect of amplitude $p \simeq 2 \times 10^{-4}$ in Hβ, with a minimum of p at $\phi \cong 0.5$, i.e. at the sharp positive maximum of H_e. Mechanisms for the polarization are discussed, with emphasis on qualitative features predicted by the general model of a symmetric, oblique rotator. The blue-band polarization of 53 Cam, when corrected by removing the interstellar component, is compatible with an oblique rotator which has angular parameters in the range $50° \lesssim (180°-i) \lesssim 60°$, and $\beta \sim 90°$, in essential agreement with the parameters deduced by Landstreet (Astrophys. J.; 159: 1001(1970)), and by Huchra (Astrophys. J.; 174:435(1972)) for the star. (auth)

24939 OBLIQUE ROTATOR MODEL FOR DQ HERCULIS. Bath, G. T.; Evans, W. D.; Pringle, J. E. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc.; 166: No. 1, 113-121(Jan 1974).

It is suggested that the old nova DQ Herculis and the known pulsing x-ray sources belong to a common class of magnetic, accreting, compact components in close semi-detached binary systems. The 71-s periodicity observed in the white dwarf component of DQ Herculis is interpreted as due to accretion hot spots on an oblique magnetic rotator. The model requires that the magnetic field is $\geq 10^6$ G and that the spots should radiate predominantly in the far uv/soft x-ray region. The model predicts a phase shift in the periodicity of $|\phi| = 360°$ through the eclipse of the white dwarf. The sign of the observed 360° phase change is inconsistent with the sign expected from this model. (auth)

24940 BREMSSTRAHLUNG MODEL OF POLARIZED RADIATION FROM MAGNETIC WHITE DWARFS. O'Connell, R. F. (Louisiana State Univ., Baton Rouge). Phys. Lett.; 46A: No. 4, 249-250(31 Dec 1973).

Motivated by the desire to provide a model for the polarized radiation observed from some white dwarfs, the intensities of right and left circularly polarized bremsstrahlung radiation emitted by electrons in the atmospheres of magnetic white dwarfs were calculated. (auth)

24941 SPECTRAL VARIATIONS IN THE EMISSION OF PLEION BETWEEN 1971 AND 1973. Delplace, A. M. (Observatoire de Paris, Meudon, France). Compt. Rend., Ser. A, B; 277: No. 19, 575-578(12 Nov 1973). (In French).

Emission from Pleion disappeared at the end of 1971; a hydrogen and metal absorbing envelope comparable to that already observed in 1938 was simultaneously observed. The time scale for the variations in emission of this B8 type star is estimated to be about 70 years. (FR)

24942 INTRODUCTION TO EXPERIMENTAL ASTRONOMY. Culver, R. B. San Francisco; W. H. Freeman and Company (1974). 200p. $4.00.

Twenty-two basic exercises are presented which provide a solid introduction to the concepts and methods employed in astronomy and astrophysics. (WDM)

24943 GENERAL ASTROPHYSICS WITH ELEMENTS OF GEOPHYSICS. Stodolkiewicz, J. S. New York; American Elsevier Publishing Company, Inc. (1973). 259p.

This book is intended as a text for a one-semester course in general astrophysics and the elements of geophysics. Topics covered include astronomical observations, motions of the Earth, physics of the solar system, stellar structure, galactic structure, interstellar matter, and extra-galactic astronomy. (WDM)

24944 CYGNIDS AND TAURIDS: TWO CLASSES OF INFRARED OBJECTS. Strecker, D. W.; Ney, E. P.; Murdock, T. L. (Univ. of Minnesota, Minneapolis). Astrophys. J.; 183: No. 1, L13-L16(1 Jul 1973).

In a study of the anonymous objects from the IRC Survey, it was found that about 10 percent have large long wave excesses. These infrared stars seem to belong to two classes, one group like NML Cygni (Cygnids) and the other like NML Tauri (Taurids). (auth)

24945 8 TO 13 MICRON SPECTRA OF NGC 7027, BD + 30°3639, AND NGC 6572. Gillett, F. C.; Forrest, W. J.; Merrill, K. M. (Univ. of California, San Diego, La Jolla). Astrophys. J.; 183: No. 1, 87-93(1 Jul 1973).

Observations of the 8 to 13-μ spectra of the planetary nebulae NGC 7027, BD + 30°3639, and NGC 6572 are presented. The spectra consist of both fine-structure line radiation and continuum radiation. The results are discussed in terms of abundances, predicted line strengths, and composition of radiating material. (auth)

24946 FUNDAMENTAL DATA FOR CONTACT BINARIES: RZ COMAE BERENICES, RZ TAURI, AND AW URSAE MAJORIS. Wilson, R. E. (Goddard Inst. for Space Studies, New York); Devinney, E. J. Astrophys. J.; 182: No. 2, 539-547(1 Jun 1973).

Differential corrections analyses of three binaries of the W UMa type show that RZ Tau and AW UMa have common envelopes and the relatively small gravity darkening predicted by Lucy, while RZ Com seems to have a larger gravity effect and is only marginally in contact. Some details of the method for computing contact-binary light curves are given. It is suggested that W UMa binaries which have occultation primary eclipses may, in general, have large amplitudes for gravity darkening or a photometric surface-brightness effect which simulates large gravity darkening. (auth)

24947 FOUR-COLOR OBSERVATIONS OF EARLY-TYPE STARS. III. M4. Philip, A. G. D. (State Univ. of New York, Albany). Astrophys. J.; 182: No. 2, 517-521(1 Jun 1973).

Four-color measures were made of ten blue-horizontal-branch stars in the globular cluster M4. The quantities θ_e and log g were calculated for stars with $0.00 \text{ mag} \leq (b-y)_0 \leq 0.12$ mag, and these parameters were in accord with the log (log g, θ_e)-relation found for NGC 6397 and other clusters by Newell. (auth)

24948 SPECTROPHOTOMETRIC STUDIES OF GASEOUS NEBULAE. XXII. The Irregular Ring Nebula NGC 6445. Aller, L. H. (Univ. of California, Los Angeles); Czyak, S. J.; Craine, E.; Kaler, J. B. Astrophys. J.; 182: No. 2, 509-515(1 Jun 1973).

The relatively high-excitation, low-surface brightness nebula NGC 6445 (8 + 3.1)° shows a spectrum characterized by strong lines of He II λ4685, [Ne III] as well as [O II] λ3727, [S II], [O I], and probably [N II]. The observational data strongly suggest an excess of helium. (auth)

24949 INFRARED PHOTOMETRY OF PLANETARY NEBULAE. Persson, S. E.; Frogel, J. A. (Harvard Coll., Cambridge, MA). Astrophys. J.; 182: No. 2, 503-507(1 Jun 1973).

Photometric observations from 1.6 to 3.5 μ of 28 planetary nebulae are presented. Most of these emit 3.5-μ radiation in excess of that expected from thermal emission by ionized gas. When combined with the measurements of Willner, Becklin, and Visvanathan, the data show that the nebulae with relatively high densities are the more likely to emit excess 3.5-μ radiation. This trend supports a model in which the excess radiation arises from dust particles that cool off as the nebulae evolve. (auth)

24950 ELECTRICAL FIELD IN ATMOSPHERES OF EARLY TYPE STARS CAUSED BY PRESSURE GRADIENT. Kopecky, M.; Kotrc, P. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 25: No. 1, 64-67(1974).

The calculations of the electric field strength, E, caused by a pressure gradient in some of Mihalas's models of atmospheres of early type stars were made. The following estimates were found: For giants with log g = 1, $E \sim 10^{-15}-10^{-13}$ CGSE, for dwarfs (log g = 4) $E \sim 10^{-11}-10^{-9}$ CGSE. (auth)

24951 PHOTOGRAPHIC PHOTOMETRY OF THE GALACTIC CLUSTER NGC 6819. Auner, G. (Univ.-Sternwarte, Vienna). Astron. Astrophys., Suppl. Ser.; 13: No. 2, 143-171(Feb 1974).

Photographic photometry was done on 891 stars in the area of the open cluster NGC 6819 down to a limiting magnitude of V = 16.6m in the UBV system. Color excess and distance modulus were determined to have values of E(B−V) = 0.28m and $(m-M)_0$ = 11.76m respectively. Strong arguments for the existence of a main sequence gap at V = 15.35m were found. A projected density diagram was set up by star counting in concentric rings; assuming the empirical density function published by King the tidal limit appeared to be 48′. (auth)

24952 RADIAL VELOCITIES FROM OBJECTIVE-PRISM PLATES IN THE DIRECTION OF THE LARGE MAGELLANIC CLOUD. List of 398 Stars, LMC Members. List of 1434 Galactic Stars, in the LMC Direction. Fehrenbach, C.; Duflot, M. (Observatoire, Marseille). Astron. Astrophys., Suppl. Ser.; 13: No. 2, 173-267(Feb 1974). (In French).

Radial velocities are given for 1832 stars from the Fehrenbach and Duflot catalogues (1970b, 1973). The stars are members of the Large Magellanic Cloud and Milky Way. (auth)

24953 CLOSE BINARY BETA LYRAE. I. Some Spectroscopic Results From the Second International Campaign. Kriz, S.; Zdarsky, F. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 25: No. 1, 1-5(1974).

The profiles of emission lines Hα, Hγ, He I 4472, and He I 6678 are given and discussed. An attempt was made to find lines of the secondary component in the spectrum, however, the result was negative. (auth)

24954 CLOSE BINARY BETA LYRAE. II. Absolute Dimensions and Properties of Components. Kriz, S. K. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 25: No. 1, 6-15(1974).

The masses, absolute dimensions, and luminosities of the components of beta Lyrae were determined. It is shown that the secondary component is probably a star of the main sequence of the spectral type B0−B2. It was found that the underluminosity of this component is much smaller than given earlier: only about 1m. It was also found that this underluminosity may be caused by the semi-transparent scattering disk around the secondary component. The effect of this disk on the light curve was estimated. It is shown that in the beta Lyrae system a Case B of mass transfer between the components is taking place, and a comparison with theoretically computed models was made. (auth)

24955 LUMINOSITY INDEX FOR BRIGHT K0−K5 STARS. Chaturvedi, J. P. (Uttar Pradesh State Observatory, Naini Tal, India). Bull. Astron. Inst. Czech.; 25: No. 1, 15-19(1974).

An index for luminosity classification of K0−K5 stars based upon broadband UBRI observations was obtained. This index was employed to obtain the MK-luminosity classifications for 21 bright stars for which only the spectral classification is so far available. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 24281, 24939, 25053, 25059, and 25941.

24956 STRUCTURE OF THE H II REGIONS M8 AND M20. II. Electron Densities. Bohuski, T. J. (McDonald Observatory, Austin, TX). Astrophys. J.; 184: No. 1, 93-102(15 Aug 1973).

Monochromatic photographs were obtained in each of the sulfur lines [S II] λλ6717, 6731 in M8 and M20 using wide slits with a medium dispersion. Observational evidence is provided for shock-front structure at bright rims in the H II regions M8 and M20, and for interaction between the ionized gas and the absorption lanes in M20. (auth)

24957 350-MICRON OBSERVATIONS OF SOURCES IN H II REGIONS, THE GALACTIC CENTER, AND NGC 253. Rieke, G. H. (Univ. of Arizona, Tucson); Harper, D. A.; Low, F. J.; Armstrong, K. R. Astrophys. J.; 183: No. 2, L67-L71(15 Jul 1973).

Observations of several sources in H II regions, including the OH source associated with DR-21, were made at 350 μ. At this wavelength, a new upper limit was obtained for the galactic center and a detection of infrared emission from the nucleus of NGC 253 was made. (auth)

24958 PRECISE POSITIONS OF RADIO SOURCES. IV. Improved Solutions and Error Analysis for 59 Sources. Brosche, P.; Wade, C. M.; Hjellming, R. M. (National Radio Astronomy Observatory, Green Bank, WV). Astrophys. J.; 183: No. 3, 805-818(1 Aug 1973).

Absolute declinations and right-ascension differences for 59 radio sources were measured with the NRAO interferometer with uncertainties of much less than 1 arc second in most cases. The dimensions and the orientation of the confidence ellipse for each position are given. (auth)

24959 STRUCTURE OF THE H II REGIONS M8 AND M20. I. Kinematics. Bohuski, T. J. (McDonald Observatory, Austin, TX). Astrophys. J.; 183: No. 3, 851-861(1 Aug 1973).

A study of Hα, [N II], and [O III] line profiles was made in M8 and M20 using a Fabry−Perot interferometer. Temperatures were estimated from both the relative widths and the relative intensities of Hα and [N II]. The two methods often showed large discrepancies. After removal of thermal Doppler broadening, the residual profile half-width was about 18 km s^{-1} for Hα and [N II], and about 12 km s^{-1} for [O III]. The observations did not verify the existence of expansion. (auth)

24960 ACCURATE POSITIONS OF OH EMISSION SOURCES AT 1665 AND 1667 MHz. Goss, W. M. (Max-Planck-Institut fuer Radioastronomie, Bonn); Lockhart, I. A.; Fomalont, E. B.; Hardebeck, E. G. Astrophys. J.; 183: No. 3, 843-850(1 Aug 1973).

Accurate positions for eight OH emission sources were measured at 1665 and 1667 MHz. The Owens Valley interferometer was used at spacings of 366 and 488 m north−south. Near the continuum sources G45.1 + 0.1 and G45.5 + 0.1, four separate OH emission regions were found. (auth)

24961 ISOTHERMAL EXPANSION OF A SPHERICAL, CYLINDRICAL, AND PLANE PISTON INTO AN INHOMOGENEOUS MEDIUM. Ashraf, S. (Indian Inst. of Science, Bangalore, India). Indian J. Pure Appl. Math.; 3: No. 5, 871-877(Sep 1972).

Approximate analytic solutions describing the uniform motion of a spherical, cylindrical, or plane piston into a nonuniform medium were obtained in which the density $\rho_0 \alpha x^{-\alpha}$, where x is the distance measured from the point or axis of symmetry and α is a positive constant. It was assumed that the flow is isothermal in the entire region behind the shock. The modified form of Chernyl's technique was used in which the flow variables are expanded in series of powers of $1/M^2$ where M is the Mach number of the shock. Comparison of the analytic solution with exact numerical results of Rogers shows an excellent agreement even up to shock Mach number equal to 1.5. (auth)

24962 COMMENTS ON THE NATURE OF THE x-RAY STARS HER X-1 AND SCO X-1. Shklovskii, I.S. (Institute of Space Research Academy of Sciences of the USSR, Moscow). Sov. Astron.–AJ 17: No. 2, 157-162 (Sept 1973).

It is shown that the picture of the x-ray emission of Her X-1 is naturally explained by an anisotropic emission mechanism (synchrotron or cyclotron) with a knife-edge directional diagram. Empirical arguments are given in favor of the hypothesis that the x-ray star Her X-1 is a neutron star and that the mechanism of x-ray emission is the accretion of gas flowing from the optical component. The evolution of the close binary system XZ Her is discussed. Grounds are given for the hypothesis that Sco X-1 is a black hole whose optical component is a dwarf flare star of the UV Ceti type. (auth)

24963 TWO-COMPONENT EQUILIBRIUM MODEL OF INTERSTELLAR HI REGIONS THAT SATISFY THE OVERALL RADIO OBSERVATIONS. Beisekova, G.K.; Bochkarev, N.G. (P. K. Shternberg State Astronomical Institute). Sov. Astron.–AJ 17: No. 2, 272-273 (Sept 1973).

A two-component equilibrium model of the interstellar HI regions has been constructed. It satisfies, at the same time, the data in ref. 1. with hydrogen concentrations in the clouds $n_c \simeq 6$ cm^{-3} and the data in ref. 3 on the clouds' temperature $T_c = 70$–80°K, which gives a value, averaged over the line of sight, of the electron concentration $\bar{n}_e \simeq 0.02$ cm^{-3}, which evidently can agree with the data from the observations of pulsars. The mean concentration of hydrogen in the arms is assumed to be $\bar{n}_H = 1$ cm^{-3}. In this model, the source of heating can only be cosmic rays. The model's sensitivity to variations in the initial parameters has been studied. (auth)

24964 SYNCHROTRON RADIATION OF THE CRAB NEBULA. Bychkov, K.V. (Special Astrophysical Observatory, Academy of Sciences of the USSR). Sov. Astron.–AJ 17: No. 2, 163-168 (Sept 1973).

The following pattern is suggested for the distribution of relativistic particles and magnetic fields in the Crab Nebula. Parallel filamentary regions would coexist, with relatively strong fields ($\simeq 10^{-3}$ gauss), whose energy far exceeds that of the cosmic rays confined by them, adjacent to weak fields ($\simeq 10^{-4}$ gauss), in which the pressure is established by relativistic particles. These regions would form as the observed "wisps" appear: Cosmic rays emanating from the region around the pulsar every three months would press their way between the magnetic-field lines of the nebula, thereby producing the weak-field regions. This interpretation aids in explaining the basic properties of the synchrotron radiation from the nebula throughout the observed frequency range, including its ratio and optical polarization. It imposes certain constraints on possible emission mechanisms in the circumpulsar region. The energy contained in the magnetic field and cosmic rays of the Crab would be about an order of magnitude greater than previously considered. (auth)

24965 OCCULTATIONS OF 50 RADIO SOURCES AT 327 MHz. Joshi, M. N.; Kapahi, V. K.; Gopal-Krishna; Sarma, N. V. G.; Swarup, G. (Tata Inst. of Fundamental Research, Bombay). Astron. J.; 78: No. 10, 1023-1029(Dec 1973).

Radio positions and brightness distributions derived from lunar occultations observed with the Ooty radio telescope at 327 MHz are reported for 50 radio sources, most of them in the flux density range of $0.3 - 2 \times 10^{-26}$ Wm^{-2} Hz^{-1}. A large majority of the sources is resolved, with angular sizes of about 2 to 20 arcsec. Only 13 sources are identified with optical objects; nine with galaxies, three with blue-stellar objects and one with a stellar object. (auth)

24966 COLLISIONLESS DAMPING OF HYDROMAGNETIC WAVES IN RELATIVISTIC PLASMA. I. Weak Landau Damping; Heating of the Crab Nebula. Barnes, A. (Ames Research Center, Moffett Field, CA); Scargle, J. D. Astrophys. J.; 184: No. 1, 251-270(15 Aug 1973).

The propagation and damping of small-amplitude waves in a plasma of relativistic electrons and/or protons is studied. As in the analogous nonrelativistic problem, the damping is found to be large except for particular angles of propagation. The results are applied, in the ultrarelativistic limit, to the problem of the heating of the high-energy electrons in the Crab Nebula. Some aspects of the morphology of the propagating disturbances near the center of the nebula can be understood in terms of the magnitude and angular dependence of the calculated damping. (auth)

24967 MODEL FOR CYGNUS X-3. Pringle, J. E. (Univ. of Sussex, Brighton, Eng.). Nature (London); 247: No. 5435, 21-22(4 Jan 1974).

It is shown that Cyg X-3 can be interpreted by means of the "standard model" for galactic x-ray sources in terms of mass loss from a large companion star and accretion on to a compact object. In the "standard model" assumed the x rays originate from a compact object and the infrared flux is due to heating of the companion star, or its extensive atmosphere or wind, by the x-ray star. A possible model for producing the x-ray light curve is outlined. It is suggested that the smooth variation of the x-ray luminosity is produced by a gradual and partial eclipse of the compact x-ray object by a stellar wind emanating from the larger companion. This same wind can also give rise to the mass transfer required to power the x-ray source, and it is assumed that the main opacity in the wind is electron scattering. (UK)

24968 X-RAYS FROM CLOSE BINARY STARS. Fabian, A.; Pringle, J. (Cambridge Univ., Eng.). New Sci.; 61: No. 884, 343-345(7 Feb 1974).

During the past three years a study has been made of a class of variable x-ray sources in our Galaxy which radiate up to a million times more powerfully than the Sun. The energy supply which powers these luminous sources of x rays is considered. It is argued that this arises from matter transferred from one star to a compact companion in a close binary system which liberates its gravitational energy as x rays, so called "accretion". (UK)

24969 DOUBLE QUASISTELLAR OBJECT. Wampler, E. J.; Baldwin, J. A.; Burke, W. L.; Robinson, L. B.; Hazard, C. (Univ. of California, Santa Cruz). Nature (London); 246: No. 5430, 203-205(23 Nov 1973).

It is stated that visually 1548 + 115 $\equiv$ 4C 11.50 is a close pair of blue stellar objects. The brighter object (1548 + 115a) is approximately 17 mag. and is accompanied 4.8 arc sec. E and 0.4 arc sec. S by the 19 mag. object 1548 + 115b. It was found that the latter object is a QSO, and it is here reported that 1548 + 115a is also a QSO. Additional spectral information is given for both objects. The objects have been found to have very different redshifts, the value for 115a being Z = 0.4359 and that for 115b 1.901. The radio source is a 3C 273 type double with one component coincident with 115a. Optical observations of the objects in August 1973 are described, made with the Cassegrain scanner of a 120 inch telescope. Best estimates for the spectral index of 115a were $\alpha = 0.8 \pm 0.5$ and for 115b 0.6 ± 0.4. Both objects showed rich emission line spectra, which are shown tabulated, and seem to be normal for QSOs. There are several coincidences in the spectra of the two objects. Observation of a close pair of QSOs with discordant redshifts is considered unlikely under the cosmological hypothesis, but is more possible under the local hypothesis. The latter would receive additional support if an interaction between the two components of a close pair could be shown. A search for more QSO pairs should include all stars found near suspected or known QSOs. (UK)

24970 OBSERVATIONS OF TEN EXTRAGALACTIC RADIO SOURCES WITH VERY STEEP SPECTRA. Slingo, A. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 1, 101-111(Jan 1974).

The Half-Mile telescope at the Mullard Radio Astronomy Observatory has been used at 1421 MHz to map ten sources which have very steep radio spectra. Of the seven sources which are coincident with clusters of galaxies, only one shows evidence for the steep spectrum being associated with a halo. The curvature noted in the spectra of two of these sources is interpreted as being due to synchrotron losses, following the withdrawal of the energy input in the form of relativistic electrons. (auth)

24971 SYNTHESIS OBSERVATIONS OF SOUTHERN RADIO SOURCES AT 1410 MHz WITH THE PARKES INTERFEROMETER. I. Instrument, Reduction, and Preliminary Results. Schwarz, U. J. (Rijksuniversiteit, Groningen, Netherlands); Cole, D. J.; Morris, D. Aust. J. Phys.; 26: No. 5, 661-673(Oct 1973).

Modifications to the Parkes interferometer are described which allow synthesis observations to be made while still retaining the flexibility of frequent baseline changes. Details are given of the receiver with a phase stabilizing device and its performance, on-line computer control, and data processing. Preliminary observations with a resolution of 1′ of the two sources PKS 2152−69 and 2356−61 and possible optical identifications are discussed briefly. (auth)

24972 PROPAGATION AND BROADENING OF PULSES IN WEAKLY IRREGULAR MEDIA. Uscinski, B. J. (Cambridge Univ., Eng.). Proc. Roy. Soc. (London), Ser. A; 336: No. 1606, 379-392(5 Feb 1974).

The radio signals received from pulsars are pulses which are frequently broadened as a result of scattering in the interstellar medium. This broadening is examined theoretically using a diffraction theory of wave propagation in weakly irregular media. The theory is valid for all distances in the scattering medium, and particular attention is paid to the transition from the regime where single scattering predominates to that where all the radiation has been multiply-scattered. Typical pulse shapes are calculated and the results are compared with the theory of pulse broadening based on geometrical optics which represents the limiting case for extreme multiple scatter. (auth)

24973 INFRARED NEBULAR LUMINOSITY VERSUS STELLAR LUMINOSITY IN FIVE H II REGIONS. Johnson, H. M. (Lockheed Missiles and Space Co., Palo Alto, CA). Astrophys. J.; 182: No. 2, 497-502(1 Jun 1973).

The ratio of stellar to nebular luminosity is found in M8, M17, M42, NGC 2024, and NGC 6357. The various observable and theoretical parameters which are brought into the comparison are clearly specified. The result is that stellar and nebular luminosities are about equal in M42, NGC 2024, and NGC 6357, within uncertainties, but infrared nebular luminosity very probably exceeds accountable stellar luminosity in M17 while the luminosity of the rich star cluster in M8 very probably exceeds the infrared nebular luminosity. (auth)

Solar Phenomena

Refer also to abstracts 24237, 24913, 25023, 25075, 25111, and 25123.

24974 (AD-763475) SEARCH FOR SOLAR NEUTRONS FROM 10 TO 100 MeV. Moon, S.; Simnett, G. M.; White, R. S. (California Univ., Riverside (USA)). 19 May 1973. Contract N00014-69-A-0200-5001. 9p. (IGPP-UCR-73-26). NTIS $3.00.

A search for solar neutrons is reported from a balloon flight launched from Palestine, Texas on September 26, 1971. The Sun was observed from 8:30 to 19:30 CST. The neutrons were detected with a telescope consisting of two 0.5 sq. m. scintillation detectors spaced 1 meter apart using a double scattering time-of-flight technique. Upper limits for solar neutrons in the energy intervals 10 to 30, 30 to 50, and 50 to 100 MeV are 1.1×10^{-4}, 2.6×10^{-4}, 5.9×10^{-4} n/cm^2-sec respectively. These are combined into an overall upper limit of 5.1×10^{-4} n/cm^2-sec. (auth)

24975 (AD-766465-9) CHARACTERISTICS OF THE AUGUST 1972 SOLAR PARTICLE EVENTS AS OBSERVED OVER THE EARTH'S POLAR CAPS. Reagan, J. B.; Imhof, W. L.; Moughan,

V. F. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Lockheed Palo Alto Research Lab.). Jun 1973. Contract N00014-70-C-0203. 24p. (LMSC-D-352207). NTIS $2.75.

The fluxes and spectra of solar protons in the energy range 1 to 100 MeV have been measured over the Earth's polar caps at an altitude of 800 km aboard the satellite 1971-089 A during the intense solar particle events of August 3-12, 1972. Differential proton fluxes in the energy intervals 1 to 4.5 MeV, 5 to 20 MeV, and 20 to 100 MeV are presented as a function of time throughout the events. The fluxes of 0.76 to 2.1 MeV energetic electrons are also presented. Differential spectra of protons, alpha particles, and electrons over the south central polar cap are shown for 1102 UT on August 4 and 0144 UT on August 9, 1972. Comparisons of the peak and integrated fluxes measured in this experiment with another measurement made during these events and with other large events in the previous solar cycle have been made. The 29 to 100 MeV proton fluxes measured over the polar caps in this experiment are in good agreement with the greater than 30-MeV proton measurements of Bostrom et al. (1972) made in interplanetary space and in the magnetosphere. The present data indicate that the August 4, 1972 event was the largest solar particle event observed near Earth in the last two decades. (auth)

24976 (AD-767971-5-GA) PARTICLE ACCELERATION IN SOLAR FLARES. Sturrock, P. A. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Sep 1973. Contract N00014-67-A-0112-0062. 19p. (SU-IPR-541). NTIS $2.75.

A review of observational data supports the proposal that there are two distinct phases of particle acceleration in solar flares. "Phase 1" is associated with the flash phase and is here interpreted as acceleration during field-line reconnection. "Phase 2" is associated with Type II and Type IV radio bursts, and is ascribed to stochastic acceleration in the turbulent plasma behind a magnetohydrodynamic shock formed ahead of an ejected plasmoid. (auth)

24977 ISOTOPE RATIO $^{12}C/^{13}C$ IN COMET TAGO–SATO–KOSAKA 1969g. Owen, T. (State Univ. of New York, Stony Brook). Astrophys. J.; 184: No. 1, 33-43(15 Aug 1973).

A spectrogram of Comet 1969g obtained with the 200-inch (508-cm) Hale telescope shows a well-developed emission feature at the position of the A–X (1-0) band head of $^{12}C^{13}C$ (4745 Å). Using new laboratory data, it is possible to remove the effect of blending with NH_2 lines at this wavelength. The corrected value of the intensity of the isotopic band head is used to derive the abundance ratio $^{12}C/^{13}C = 100 \pm 20$ for the comet. The implications of this result for models of comet formation and the early solar system are discussed. (auth)

24978 EVIDENCE FOR AN INTERSTELLAR OR INTERPLANETARY SOURCE OF DIFFUSE He I 584 Å RADIATION. Paresce, F.; Bowyer, S.; Kumar, S. (Univ. of California, Berkeley). Astrophys. J.; 183: No. 2, L87-L90(15 Jul 1973).

The intensity and spatial variations of the He I 584 Å radiation in the night sky were measured to an altitude of 264 km from a sounding rocket. The flux varied in intensity with look angle from a high of 16 ± 5 rayleighs to a low of < 1 rayleigh. Since the peak flux levels observed are approximately two orders of magnitude larger than that expected from geocoronal resonant scattering, the results were compared with those expected from two interplanetary sources of neutral helium: the penetration of the local interstellar medium into the solar neighborhood and the dust deionization of solar-wind alpha particles. If currently tenable nominal input parameters for these sources are used, the data are much better fitted by the dust de-ionization source. However, both sources are compatible with the data to within the uncertainities of the models. (auth)

24979 FORMATION OF PLANETESIMALS. Goldreich, P.; Ward, W. R. (California Inst. of Tech., Pasadena). Astrophys. J.; 183: No. 3, 1051-1061(1 Aug 1973).

Four stages in the accretion of planetesimals are described. The initial stage is the condensation of dust particles from the gaseous solar nebula as it cools. These dust particles settle into a thin disk which is gravitationally unstable. A first generation of planetesimals, whose radii range up to $\sim 10^{-1}$ km, form from the dust disk by direct gravitational collapse to solid densities on a time scale of the order of 1 year. The resulting disk, composed of first-generation planetesimals, is still gravitationally unstable, and the planetesimals are grouped into clusters containing approximately 10^4 members. The contraction of these clusters is controlled by the rate at which gas drag damps their internal rotational and random kinetic energies. On a time scale of a few thousand years, the clusters contract to form a second generation of planetesimals having radii of the order of 5 km. Further coalescence of planetesimals proceeds by direct collisions which seem capable of producing growth at a rate of the order of 15 cm per year at 1 AU. The final stage of accretion during which planet-sized objects form is not considered here. (auth)

24980 METAL LINES IN THE SOLAR FLARE OF JULY 12, 1961, AND THE PROPERTIES OF THE EMISSION REGION. Shilova, N.S. (Institute of Terrestrial Magnetism, the Ionosphere, and Radio-Wave Propagation). Sov. Astron.-AJ 17: No. 2, 219-222 (Sept 1973).

The intensities of neutral and singly ionized metal lines in the spectrum of an importance 3+ flare are analyzed. These lines are indicative of emission in the coolest regions of flares. It is shown that: 1) the temperature in the metal emission region of the flare is somewhat lower than in the undisturbed chromosphere; 2) for most metals the degree of ionization is no higher in the flare than in the chromosphere; 3) individual components of certain multiplets appear in the flare but not in the chromosphere, evidently because the electron density is at least an order of magnitude higher in the flare. (auth)

24981 DAMPING CONSTANTS AND TURBULENCE VELOCITIES IN THE SOLAR PHOTOSPHERE DETERMINED BY THE VOIGT METHOD. Mitropol'skaya, O.N.; Sitnik, G.F. (Shternberg Astronomical Institute, Moscow). Sov. Astron.-AJ 17: No. 2, 223-225 (Sept 1973).

Photoelectric profiles have been obtained for nine lines of neutral and ionized atoms at various distances from the center of the solar disk. Damping constants and turbulence velocities have been computed from these profiles by the Voigt method. In some cases the dependence of the damping constant on cos θ does not agree with its theoretical rise with depth. This behavior may occur because the wings of a line formed at a given depth are filled in with continuum radiation from the layers above, an interpretation supported by the dependence of the damping constant on cos θ for lines of atoms and ions with different excitation potentials. The damping constant increases with cos θ for lines formed in the upper photosphere. For lines formed in deep layers it decreases until the depth of formation exceeds the thickness of the layer responsible for blurring the line; the blurring effect then becomes constant and the damping increases with depth because of the rising density. The line blurring has practically no effect on the determination of the turbulence velocity. (auth)

24982 FIRST ORDER LATITUDE EFFECTS IN THE SOLAR WIND. Winge, C. R. Jr.; Coleman, P. J. Jr. (Univ. of California, Los Angeles). Planet. Space Sci.; 22: No. 3, 439-463(Mar 1974).

The Weber–Davis (Astrophys. J.; 148: 217 (1967)) model of the solar wind is generalized to include the effects of latitude. The principal assumptions are retained but the original three-dimensional magnetohydrodynamic flow problem is reduced to a two-dimensional hydrodynamic flow problem in the $r-\theta$ plane. There are three critical surfaces associated with the equations which supply conditions to determine three of six required boundary conditions. The specified boundary conditions at the base of the corona are the temperature, density, and magnitude of the magnetic field. The equations are then expanded about the radial, nonrotating Parker (Astrophys. J.; 128: 664 (1958)) solution and an analytic solution is obtained for the resulting first order equations. The results show that for constant coronal boundary conditions there is a latitudinal flow toward the solar poles, as a result of magnetic stresses, which persists out to large distances for the Sun. Associated with this flow is a latitudinal component of the magnetic field. The radial flow parameters are, to within small first order differences, in agreement with those of the Parker and the Weber–Davis models of the solar wind. The equations are further generalized to permit first order latitudinal variations in the specified coronal boundary conditions. Results at 1 au are presented for 5% latitudinal differences between the equatorial and polar values. These results show that the solution at 1 au is most sensitive to a latitudinal dependence in the boundary temperature and least sensitive to a latitudinal dependence in the magnetic-field magnitude. A solution is then obtained for an approximate dipolar variation in the coronal magnetic field magnitude. This solution predicts that the latitudinal flow is initially toward the Equator due to magnetic channeling; however, this effect is rapidly overcome and the latitudinal flow at 1 au is toward the pole and not significantly different from the solution for constant boundary conditions. (auth)

24983 CORONAL REFRACTION AND THE EINSTEIN EFFECT. Argence, E. (Institut Franco-Allemand de Recherches, Saint-Louis, France). Compt. Rend., Ser. A, B; 277: No. 16, 817-820(22 Oct 1973). (In French).

The deviation of an electromagnetic ray refracted by the solar corona was theoretically studied, reference being made to a previous paper. This deviation is compared to that produced by the gravitational field (Einstein effect). Applications to radio sources and radar-astronomy are envisaged. (FR)

24984 SPONTANEOUS BOUND–FREE TRANSITIONS OF THE $2p^2\ ^3P^e$ STATE OF H^-. Drake, G. W. F. (Univ. of Windsor, Ont.). Astrophys. J.; 184: No. 1, 145-150(15 Aug 1973).

The rate of spontaneous emission of radiation by the $2p^2\ {}^3P^e$ state of H^- is calculated to be $5.77 \times 10^{-3}\ s^{-1}$. The dominant decay mode is to the 1skp ${}^3P^0$ continuum, producing a broad spectral feature on the long-wavelength side of Lα. The emission spectrum of H^- may contribute significantly to the solar continuum at wavelengths longer than 1217 Å. It is shown that a discrete variational basis set provides a good representation for the continuum oscillator-strength density. (auth)

24985 NATURE OF MICROTURBULENCE IN THE SOLAR PHOTOSPHERE. Wilson, A. M.; Guidry, F. J. (Goddard Space Flight Center, Greenbelt, MD). Mon. Notic. Roy. Astron. Soc.; 166: No. 1, 219-233(Jan 1974).

This paper contains two main results: (i) The apparent centre–limb increase of Doppler width in the cores of the sodium D lines is not caused by the frequency dependence of the lines source function. (ii) The increase in Doppler width in these lines as the limb is approached is probably due to the inhomogeneous structure of the upper photosphere. (auth)

24986 THEORY OF FINITE-AMPLITUDE OVERSTABILITY AND ITS APPLICATION TO PERIODIC MOTIONS IN SUNSPOTS. Van der Borght, R. (Monash Univ., Clayton, Australia). Mon. Notic. Roy. Astron. Soc.; 166: No. 1, 191-202(Jan 1974).

A theory is developed for the study of overstable motions in a fluid layer, within the Boussinesq approximation. The results are then applied to observed periodic motions in the umbra of sunspots. (auth)

24987 EXTRA-TERRESTRIAL ^{53}Mn IN ANTARCTIC ICE. Bibron, R. (CEN, Saclay, France); Chesselet, R.; Crozaz, G.; Leger, G.; Mennessier, J. P.; Picciotto, E. Earth Planet. Sci. Lett.; 21: No. 2, 109-116(Jan 1974).

The reasons why ^{53}Mn (a cosmogenic radionuclide with a half-life of 3.7×10^6 y) appears as one of the best indicators of the presence of interplanetary dust are summarized. This paper reports the detection of ^{53}Mn in pre-1952 snow samples collected on the Eastern Antarctic Plateau in the vicinity of Plateau Station. The measurements were carried out by neutron activation and x-ray spectrometry on three samples weighing a few hundred kg and covering each the time interval 1935–1950. The specific activity of ^{53}Mn was found to be (0.82 ± 0.17) disint. $min^{-1}/10^3$ tons of snow, corresponding to a deposition rate at Plateau Station of $(2.2 \pm 0.5) \times 10^{-5}$ disint. $min^{-1}\ m^{-2}\ y^{-1}$. The mean global deposition rate would be three times higher if ^{53}Mn were assumed to behave in the same way as stratospheric ^{90}Sr. By comparing this figure with existing data on the meteorite flux reaching the Earth and with the galactic and solar production rates of ^{53}Mn, it is concluded that the bulk of the ^{53}Mn found at Plateau Station is associated with interplanetary dust in which it had been produced by the action of solar protons on iron. The deposition rate of extraterrestrial dust-borne iron must be between 1.3×10^{-5} and $1.3 \times 10^{-4}\ g\ m^{-2}\ y^{-1}$ at Plateau Station. These results support jointly with other studies the concept of an interplanetary zodiacal cloud of dust with a chemical composition and density not essentially different from chondritic meteorites, with a relatively "flat" grain size distribution and a mass influx to the Earth of the order of 10^5 tons/y. (auth)

24988 SURFACE PROPERTIES OF THE ORGUEIL METEORITE: IMPLICATIONS FOR THE EARLY HISTORY OF SOLAR SYSTEM VOLATILES. Fanale, F. P.; Cannon, W. A. (Jet Propulsion Lab., Pasadena, CA). Geochim. Cosmochim. Acta; 38: No. 3, 453-470(Mar 1974).

Dehydration of Orgueil by stepwise calcination produced more than a tenfold change in its Kr B.E.T. surface area which increased to 120 m^2/g, then fell to 40 m^2/g. This phenomenon characterizes structures of the montmorillonite type, but not other plausible constituents of Orgueil. It results from vacating of interlayer sites by H_2O molecules which are replaced by Kr until finally the sheets collapse, excluding Kr. Differential calorimetric scans of Orgueil also gave a better match for montmorillonite than for other minerals. However, a simple identification as montmorillonite conflicts with chemical analyses of Orgueil phyllosilicates. Exchangeability of H_2O in Orgueil was shown by water regain from lab air between calcination cycles and similarity of the cycles. Room temperature dehydration revealed up to 6 percent free surface adsorbed water. High D/H ratios in CIs may result from D enrichment in OH^- groups during equilibration of dispersed phyllosilicate dust with nebula gas at temperatures ≪0°C. Adsorption on the very large free and interlayer surface areas of this dust was the major mechanism by which volatiles still uncondensed at the time of gas–dust separation (including planetary primordial Ar, Kr, and Xe) were incorporated into solid solar system material. (auth)

24989 RELATIONSHIP BETWEEN SHOCK WAVE AND MAGNETIC BOTTLE ASSOCIATED WITH THE SOLAR FLARE OF 4 November 1968. Sakurai, K.; Chao, J. K. (National Aeronautics and Space Administration, Greenbelt, MD). Planet. Space Sci.; 22: No. 3, 493-494(Mar 1974).

This note discusses the relation between shock wave and magnetic bottle, which were both associated with the solar proton flare of November 4, 1968. In particular, the formation and development of this wave and bottle are described. (auth)

24990 PRELIMINARY STUDY OF THE EXTREME ULTRAVIOLET SPECTROHELIOGRAMS FROM SKYLAB. Tousey, R.; Bartoe, J. D. F.; Bohlin, J. D.; Brueckner, G. E.; Purcell, J. D.; Scherrer, V. E.; Sheeley, N. R. Jr.; Schumacher, R. J.; Vanhoosier, M. E. (Naval Research Lab., Washington, DC). Solar Phys.; 33: No. 2, 265-280(Dec 1973).

Some of the first observations obtained with the Naval Research Laboratory's Extreme Ultraviolet Spectrograph (S082A) during the first Skylab mission are presented and compared with magnetograms and other ground-based data. The instrument is a slitless objective-type grating spectrograph covering 170 to 630 Å and described in Solar Phys. 27, 251 (1972). Chromospheric network, loop prominences, active regions, a flare, limb brightening, xuv bright points, and "coronal holes" are among the phenomena shown and discussed. (auth)

24991 SOLAR FILIGREE. Dunn, R. B.; Zirker, J. B. (Air Force Cambridge Research Labs., Sunspot, NM). Solar Phys.; 33: No. 2, 281-304(Dec 1973).

As a birefringent filter is tuned from the center of Hα to the continuum the Hα bright mottles appear to break up into a network of grains. The name "filigree" is suggested for this bright network. Its size, shape, contrast and time evolution are described as well as its relation to the "abnormal" granulation, magnetic field, and spicules. (auth)

24992 MAGNETIC CONVECTION. Schatten, K. H. (Victoria Univ. of Wellington, New Zealand). Solar Phys.; 33: No. 2, 305-318(Dec 1973).

The process of magnetic convection is studied. It is shown that outside of a radius of about 2×10^5 km, magnetic fields in the Sun may be buoyant. Outside this limit strong field regions tend to rise at the expense of weak field regions which tend to sink. Magnetic convection may be important in magnetic stars and even in the solar interior. A recent calculation of the angular velocity of the Sun provides a period of rotation for the solar core of from 0.5 to 5 days. This calculation requires that the magnetic field extract angular momentum from the solar interior. Magnetic convection thus seems to be required, if this calculation is correct. Furthermore, magnetic convection may transfer heat and thereby possibly change the internal temperature structure of the Sun from what would be expected solely by radiation transfer. (auth)

24993 OBSERVATIONAL STUDY OF THE FIVE-MINUTE OSCILLATIONS IN THE SOLAR ATMOSPHERE. I. Oscillatory Velocity and Intensity Fields. Sivaraman, K. R. (Indian Inst. of Astrophysics, Kodaikanal). Solar Phys.; 33: No. 2, 319-331 (Dec 1973).

The 5-min oscillations in the photospheric velocity fields were studied in detail from measurements on 14 absorption lines from three time sequences of spectrograms of high quality. The lines covered a range of heights in the solar atmosphere from $\log \tau = +0.2$ to -1.2. Regions oscillating coherently were seen to have an average dimension of 8000 km and the oscillations in general lasted for 2 to 3 periods. The power spectrum analysis of high resolution enabled the determination of the period of oscillation at each level very precisely. The period decreases with increase in height, being 304 s at the level $\log \tau = +0.2$ and 295 s at the level $\log \tau = -1.2$. The low level lines possess considerable power in the low frequency range representing the convective overshoot from below. The oscillatory power increases with height, while the low frequency power decreases and the high frequency component remains substantially constant in the heights studied. The intensity fluctuations in the continuum, the line wing and core of Fe I 6358.695 were also studied. The continuum power spectrum has practically all the power near the zero frequency range, with a very weak oscillatory component. The line wing intensity fluctuations resemble those in the continuum, whereas the line core clearly shows an oscillatory component similar to the velocity oscillations. (auth)

24994 OBSERVATIONAL STUDY OF THE FIVE-MINUTE OSCILLATIONS IN THE SOLAR ATMOSPHERE. II. Coherence and Phase Spectra of Velocity and Intensity Fluctuations. Sivaraman, K. R. (Indian Inst. of Astrophysics, Kodaikanal). Solar Phys.; 33: No. 2, 333-340(Dec 1973).

The coherence and phase spectra between velocity oscillations in different pairs of lines were studied. The oscillation in the high level lines was found to lag behind those in the low level lines in general. There is high coherence between oscillations at the different levels. The phase differences between the velocities have insignificant values in the resonance range. This is taken to mean that they are standing waves. In the high-frequency range the phase difference observed is appropriate for the propagation of sound waves. The coherence and phase spectra of (i) the continuum brightness with the line wing and core brightness of Fe I 6358.695, and (ii) the continuum, line wing and core brightness of Fe I 6358.695 with the velocity fluctuations in the same line, were studied. The core brightness leads the continuum by 57° in the resonance range. The intensity oscillations in the line core lead the velocity oscillations by 93.5°. This is taken as an additional evidence for the existence of standing waves. (auth)

24995 DISTRIBUTION OF TEMPERATURE AND EMISSION MEASURE IN A STEADILY HEATED SOLAR ATMOSPHERE. Shmeleva, O. P. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow); Syrovatskii, S. I. Solar Phys.; 33: No. 2, 341-362(Dec 1973).

The distribution of temperature and emission measure in the stationary heated solar atmosphere was found for the limiting cases of slow and fast heating, when either the gas pressure or the concentration is constant through the layer depth. Results are relevant to the conditions when the energy injected by waves or by nonthermal particles or in some different way quickly transforms into a thermal flux. Under these conditions the temperature distribution with depth is determined by radiation loss and thermal conductivity, and at any values of energy flux and plasma concentration it is characterized by two universal functions. One of them gives the relation between the energy flux and temperature at the region boundary, the other, the temperature run with the depth. This run is such that a considerable part of the energy is radiated by a thin transition region with a very large temperature gradient. The results may be applied for calculation of the temperature and the emission measure both for the high temperature region of a flare, and for the quiet corona. The dimensionless structure of the transition region is the same for any value of the energy flux. These results concerning solar flares can help to explain the identity of optical spectra for flares of different types, the emission in a wide temperature interval from nearly the same region of space and the very small thickness of the region emitting optical lines. The latter is due to the "shell" structure of the flare as opposed to the usually assumed filamentary one. (auth)

24996 SOLAR ATMOSPHERIC HEATING. Piddington, J. H. (National Standards Lab., Sydney). Solar Phys.; 33: No. 2, 363-373(Dec 1973).

The solar atmosphere is heated by a flux of mechanical waves propagating in one or more of the modes: acoustic, Alfvén, and gravitational. The acoustic theory is compared with observational data and found inadequate. First, the theory is based quantitatively on the Böhm–Vitense convection zone model, and large-scale convective motions (supergranulation) and magnetic fields (unipolar regions) show that convection has another form. On the other hand, when granular motions are invoked the energy flux is too small. Second, atmospheric heating is localized in faculae, and enhanced acoustic flux beneath these regions is no longer explicable. Finally, the short periods of 10 to 30 s invoked recently appear inexplicable. Objections to the gravitational wave heating process are given briefly. Previous objections to Alfvén waves as an energy source followed from the belief that fields were generally uniform and of strength ≤50 G, now known to be incorrect. Models of Alfvén wave generation are based on (i) granule eddy motions, (ii) overstable oscillations in subsurface flux tubes and sunspot flux ropes, and (iii) supergranule motions, both horizontal and vertical. The first provides waves which propagate along thin flux tubes oscillating as taut wires in a compressible fluid; they may explain mottles, fibrils, and other small emission features. The second may explain the enormous dissipation in spot groups, including flares. The third has been invoked earlier to explain spicules, and may have effects in the solar wind. (auth)

24997 LINE-INTENSITIES IN THE PHOTOSPHERE–CHROMOSPHERE TRANSITION REGION. II. Observational Material from the 1961 Eclipse at Brac. van Dessel, E. L. (Kon. Sterrewacht van Belgiee, Brussels); Houtgast, J.; Koelbloed, D. Solar Phys.; 33: No. 2, 375-391(Dec 1973).

Results from eclipse spectra in the wavelength region 4588–4682 Å, taken during the eclipse of February 15, 1961 at Brac, Yugoslavia, are presented. Absolute line intensities were determined in the photosphere–chromosphere transition region. The method of reduction is discussed and the observed variation of the total intensity as a function of the height is shown for a number of lines. The results for the Fe I lines are compared with computations (as described in Paper I: van Dessel, 1970) for various solar model atmospheres. The model, which combines Holweger's (1967) temperature distribution for the excitation temperature with the HSRA model (Gingerich et al., 1971) for the electron temperature, yields a better agreement than all pure LTE-models. (auth)

24998 INFLUENCE OF MOLECULAR BLENDS AND NON-THERMAL LINE BROADENING OF THE PROFILE OF THE ZEEMAN TRIPLET LAMBDA 5250.22 IN SUNSPOTS. Moe, O. K. (Univ. of Oslo). Solar Phys.; 33: No. 2, 393-401(Dec 1973).

Calculations of the umbral profile of the Zeeman triplet λ5250.22 are presented. The effect of a molecular blend from TiO at λ5250.24 causing an apparent π-component even for longitudinal magnetic fields was taken into account. Also included was the depression of the spot continuum due to line wings and veiled weak lines in the umbra spectrum. The effect of different amounts of nonthermal broadening was investigated. The results point to the need of a better theoretical treatment of molecular and atomic blends and to the importance of more reliable values for the nonthermal broadening in sunspots. Furthermore, the importance of a proper stray light correction is noted, particularly including the stray light from the penumbra. (auth)

24999 SIMPLE MAGNETOSTATIC MODEL OF SUNSPOTS. Busse, F. H. (Univ. of California, Los Angeles). Solar Phys.; 33: No. 2, 413-423(Dec 1973).

An analytical solution is derived for the nonlinear magnetostatic balance between the Lorentz forces on one side and the pressure and gravitational forces induced by the magnetic inhibition of granular convection in a sunspot on the other. In order to exhibit the mathematical structure of the problem it has been reduced to the simplest case which still contains the basic physical features. Although the results of a model with a two-dimensional periodic magnetic field are not quantitatively comparable with sunspot observations the conclusion can be drawn that an upper limit on the size of sunspots exists. The results suggest that this upper limit is close to the size of observed large sunspots. (auth)

25000 SOLAR ROTATION IN THE CHROMOSPHERE AND CORONA. Henze, W. Jr.; Dupree, A. K. (Harvard Coll. Observatory, Cambridge, MA). Solar Phys.; 33: No. 2, 425-429 (Dec 1973).

Extreme ultraviolet spectroheliograms in Mg x (625 Å) and the Lyman continuum (897 Å) obtained from OSO-6 were used to determine the differential rotation rate in the solar chromosphere and corona. The equatorial rotation rate agrees with spectroscopic measurements of the photospheric plasma velocity; the variation of rate with latitude is less pronounced than in most other determinations. A variation in the rotation rate between the chromosphere and corona is not discerned. (auth)

25001 FLARE-ASSOCIATED THERMAL BURST IN THE MM-WAVE REGION. Akabane, K.; Nakajima, H.; Ohki, K.; Moriyama, F.; Miyaji, T. (Tokyo Astronomical Observatory). Solar Phys.; 33: No. 2, 431-437(Dec 1973).

A mm-wave thermal burst was observed at 73 GHz. The simultaneous observation at 17 GHz revealed that this mm-wave burst was quite a different component from the nonthermal burst coexisting at a cm-wavelength range. Since the source of this burst seemed to be opaque or nearly opaque, the temperature became several tens of thousands degrees. Considering also the similarity between time profiles of the 73 GHz intensity and the Hα light curve, it is concluded that this mm-wave burst is situated very close to the Hα flare region. (auth)

25002 DECREASE OF 2800 MHz SOLAR RADIO EMISSION ASSOCIATED WITH A MOVING DARK FILAMENT BEFORE THE FLARE OF MAY 19, 1969. Covington, A. E. (National Research Council, Ottawa). Solar Phys.; 33: No. 2, 439-444(Dec 1973).

A decrease in the total flux at 2800 MHz, or a "negative burst" was observed 15 min before the onset of the short duration, impulsive burst of May 19, 1969 at 14:30 UT and continued for another 16 min. It had been recognized originally in the records from the Algonquin Radio Observatory only as a fluctuation in a long enduring, gradual rise and fall event which had commenced at 12:40 UT. A detailed account of the radio flux variations in relation to the optical activity as described by Vorpahl (1973) is given and indicates that the onset of the negative burst and the southward motion of a dark filament are associated. (auth)

25003 MAGNETIC FIELDS, LOOP PROMINENCES AND THE GREAT FLARES OF AUGUST, 1972. Rust, D. M.; Bar, V. (Air Force Cambridge Research Labs., Sunspot, NM). Solar Phys.; 33: No. 2, 445-459(Dec 1973).

Lines of magnetic force, computed under the assumption that the solar corona is free of electric currents, were compared with loop prominence systems associated with three flares in August, 1972. The computed fields closely matched the observations of loops at a height of 40,000 km at times 3 to 4 h after onset of the associated flares. Inferred magnetic field intensities in the loops ranged from 1300 G where the loops converged into a sunspot to 50 to 80 G at 40,000 km above the photosphere. The first-seen and lowest-lying loops were sheared with respect to the calculated fields. Higher loops conformed more closely to the current-free fieldlines. A model of Barnes and Sturrock was used to relate the degree of shear to the excess magnetic energy available during the flare of August 7. On various lines of evidence, it is suggested that magnetic energy was available to accelerate particles not only during the impulsive phase of the flare, but also during the following 2 to 3 h. The particle acceleration region seemed to be in the magnetic fields just above the visible loops. The bright outer edges of the flare ribbons were identified as particle impact regions. The dense knots of loop prominence material fell to the ribbons' inner edges. (auth)

25004 DETAILED COMPARISON OF TYPE III RADIO BURSTS WITH Hα ACTIVITY. II. The Isolated Type III Activity of March and April 1971. Kuiper, T. B. (Univ. of Maryland, College Park). Solar Phys.; 33: No. 2, 461-474(Dec 1973).

Isolated Type III radio burst activity was observed at Clark Lake Radio Observatory in March and the first part of April, 1971, to occur in discrete regions of the corona above certain active regions. When these regions were examined under high resolution in Hα all the Type III events appeared to have associated activity in Hα. The potential coronal magnetic field in these regions appeared to be either open or diverging, whereas the field over a rather active region which did not have radio burst activity was closed in a magnetic arcade. The latter feature has been associated with streamers. Streamers have also been associated with dark filaments. The occurrence of a stable dark filament in an active region appeared to have an inhibiting effect on Type III activity. It is suggested that a streamer field configuration is not favorable to the escape of isolated Type III exciters. (auth)

25005 PULSATING TYPE IV SOLAR RADIO BURSTS. Gotwols, B. L. (Johns Hopkins Univ., Silver Spring, MD). Solar Phys.; 33: No. 2, 475-482(Dec 1973).

Several models for pulsating Type IV ratio bursts are presented based on the assumption that the pulsations are the result of fluctuations in the synchrotron emission due to small variations in the magnetic field of the source. It is shown that a source that is optically thick at low frequencies due to synchrotron self-absorption exhibits pulsations that occur in two bands situated on either side of the spectral peak. The pulsations in the two bands are 180° out of phase and the band of pulsations at the higher frequencies is the more intense. In contrast, a synchrotron source that is optically thin at all frequencies and whose low frequency emission is suppressed due to the Razin effect develops only a single band of pulsations around the frequency of maximum emission. However, the flux density associated with the later model would be too small to explain the more intense pulsations that have been observed unless the source area is considerably larger than presently seems reasonable. (auth)

25006 LARGE-SCALE STRUCTURE OF THE INTERPLANETARY MEDIUM. II. Evolving Magnetic Configurations Deduced from Multi-Spacecraft Observations. Nolte, J. T.; Roelof, E. C. (Univ. of New Hampshire, Durham). Solar Phys.; 33: No. 2, 483-504(Dec 1973).

A method is introduced for constructing large-scale (~0.25 AU) interplanetary magnetic field lines using only solar-wind velocity from well-separated appropriately located spacecraft. The technique is based on "labeling" the field lines at each spacecraft with their coronal connection longitudes calculated in the EQRH (extrapolated quasi-radial hypervelocity) approximation (Nolte and Roelof, 1973). Even though the EQRH approximation is most applicable to quasi-steady solar wind, it is proposed that it should also be satisfactorily accurate for moderately evolving conditions. For strongly evolving conditions (e.g., flare-associated plasma) a straightforward correction is proposed based on the inferred coronal longitudinal velocity profile. To illustrate the multi-spacecraft EQRH technique, a calculation was performed in which the interplanetary field lines in a model evolving solar-wind disturbance are deduced from model observations at separated spacecraft. Since the expected agreement is found, data from Pioneers 8 and 9 and Vela were used to construct field lines for an unusually quiet period (April 26–30, 1969) and for a flare-associated disturbance accompanied by a Forbush decrease (March 23–25, 1969). The deduced field lines (even though strongly distorted by the disturbance), order the onsets of the Forbush decrease at the separated spacecraft, and the interplanetary plasma and field structures correspond to equatorial structures apparent in Hα synoptic charts of chromospheric magnetic features. (auth)

25007 SHORT AND LONG-TERM VARIATIONS IN THE COSMIC-RAY INTENSITY AND THEIR CONNECTION WITH THE 5303 Å CORONAL LINE INTENSITY IN SOLAR CYCLE NO. 20. Iucci, N.; Parisi, M.; Villoresi, G. (Univ., Rome). Solar Phys.; 33: No. 2, 505-519(Dec 1973).

The cosmic-ray modulation in the period 1965–70 was investigated by comparison of the intensity data of groundbased stations with different response to primaries. The so-called step-like modulation, already observed by other authors, was found to be produced by the overlapping between the quasi-stationary solar-cycle modulation and the Forbush decrease events. Moreover a good correlation between the cosmic-ray variance (Forbush decrease index) and the λ5303 coronal intensity at middle heliolatitudes (17.5° to 42.5°) was found, while the quasi-stationary solar cycle modulation is well correlated with the λ5303 intensity near the solar equator (0° to 17.5°). The different time behavior of the solar activity at different heliolatitudes causes the step-like modulation. (auth)

25008 EFFECT OF PARTIAL IONIZATION OF A GAS ON THE ELECTRICAL CONDUCTIVITY, WITH REFERENCE TO SUNSPOT UMBRAE. Gurbutt, P. A. (Dept. of Applied Mathematics and Theoretical Physics, Cambridge, Eng.). Solar Phys.; 33: No. 2, 403-412(Dec 1973).

Partial ionization of a gas allows anisotropies in the electrical conductivity in the presence of a magnetic field. The components of the conductivity tensor are calculated using the data from three sunspot models. The largest component of electrical resistivity is found to be at least an order of magnitude smaller than the thermal diffusivity in the same region. (auth)

25009 COMBINED EFFECT OF ROTATION AND MAGNETIC FIELD ON FINITE-AMPLITUDE THERMAL CONVECTION. Van der Borght, R.; Murphy, J. O. (Monash Univ., Clayton, Australia). Aust. J. Phys.; 26: No. 5, 617-643(Oct 1973).

The combined effect of an imposed rotation and magnetic field on convective transfer in a horizontal Boussinesq layer of fluid heated from below is studied in the mean field approximation. The basic equations are derived by a variational technique and their solutions are then found over a wide range of conditions, in the case of free boundaries, by numerical and analytic techniques, in particular by asymptotic and perturbation methods. The results obtained by the different techniques are shown to be in excellent agreement. As for the linear theory, the calculations predict that the simultaneous presence of a magnetic field and rotation may produce conflicting tendencies. (auth)

25010 COSMIC RADIATION FROM THE FAR SIDE OF THE SUN. Krivsky, L. (Inst. of Astronomy, Prague). Vesmir; 52: No. 5, 149-150(1973).

Findings are presented demonstrated by the event of September 1, 1971, when the x-ray emission flare originated from a coronal condensation formed by an eruption situated in lower levels; the condensation extended to a minimum height of 150 thousand kilometers above the chromospheric eruption. The findings are significant not only for solar research but also for space flight forecasting. Originally, it had not been envisaged that very fast particles might have got from their sources on the far side of the Sun into the Earth's environment in such a vast number. (INIS)

25011 SOLAR WIND INTERACTION WITH LUNAR MAGNETIC FIELDS. Siscoe, G. L. (Univ. of California, Los Angeles); Goldstein, B. J. Geophys. Res.; 78: No. 28, 6741-6748(1 Oct 1973).

Two basic interaction modes have been identified: (1) deflection currents that close above the surface, typified by a subsurface dipole with its axis perpendicular to the surface, and (2) deflection currents that intersect the lunar surface, typified by a subsurface dipole with its axis parallel to the surface. The first results in a compression of the lunar field and, if it is strong enough, can stop the wind above the surface. The extent of compression depends on how much the wind is slowed before striking the surface. The second mode results in a small deflection of the wind. In both modes, charging up of the surface is important. The effects of discharging the surface charge through the photolayer and the lunar crust are found to be unimportant for typical lunar parameters. (auth)

25012 POWER SPECTRA OF SOLAR WIND PARAMETERS AT 20 SOLAR RADII DERIVED FROM MARINER 5 DATA. Lewis, R. R. (Hughes Research Lab., Malibu, CA); Siscoe, G. L. J. Geophys. Res.; 78: No. 28, 6777-6779(1 Oct 1973).

Power spectra from Mariner 5 have been mapped to a distance of 20 R_s by a linearized hydrodynamic nonspherical symmetric model in which solar-wind structure is assumed to corotate with the Sun. Results show that power in velocity and temperature is higher at 20 R_s than at the Mariner 5 location. The power in the density is less at 20 R_s than at the Mariner 5 location for fluctuations whose periods are less than 4.5 days, and it is greater at 20 R_s than at the Mariner 5 location for greater periods. This result is interpreted as growth of density between 20 R_s and Earth due to a stream–stream interaction. (auth)

25013 COMMENTS ON PAPER BY T. E. GRAEDEL AND L. J. LANZEROTTI, "INTERPLANETARY-PARTICLE ASSOCIATIONS WITH TYPE III SOLAR BURSTS". Lin, R. P. (Univ. of California, Berkeley). J. Geophys. Res.; 78: No. 28, 6821-6826 (1 Oct 1973).

It is argued that Graedel and Lanzerotti's conclusion is unsupported by the evidence and that if their analysis is performed correctly the results support the association of Type III bursts and >40-keV electron events. A reply by Graedel and Lanzerotti is included. (WDM)

25014 INDUCED MAGNETOSPHERE OF THE MOON. 2. Experimental Results from Apollo 12 and Explorer 35. Smith, B. F. (Ames Research Center, Moffett Field, CA); Colburn, D. S.; Schubert, G.; Schwartz, K.; Sonett, C. P. J. Geophys. Res.; 78: No. 25, 5437-5448(1 Sep 1973).

The asymmetric lunar electromagnetic induction theory of Schubert et al. (1973a) is tested by using data from Apollo 12 Lunar Surface Magnetometer and from the Ames magnetometer on Explorer 35. The comparison of data and theory shows that the Moon displays an induction asymmetry due to the flow of the solar wind and the formation of the diamagnetic cavity on the darkside, i.e., the component transfer functions are found to depend on local time. Vacuum theory is a poor description of the darkside induction; symmetric plasma confinement theory applied to the frontside also is incorrect, but the errors introduced are smaller than for the darkside. It is inferred that the induced field forms a magnetosphericlike configuration, with the field confined mostly to the crust of the Moon. Although the magnetospheric spectrum is time dependent, for all frequencies examined, the distance traveled by the solar wind is so large that a quasi-static magnetospheric configuration can be assumed. The differential power spectrum of the interplanetary magnetic field that excites the Moon is compared with the resulting induction spectrum, which has a linear differential power frequency dependence over the frequency range 2×10^{-4} to 2×10^{-2} Hz, falling off on either side of these limits. The integrated power in this band is about 5 γ^2 for the interplanetary field local north–south component and about 12 γ^2 for the induced spectrum of this component on the lunar surface. Calculated magnetic field line configurations are shown for the Moon immersed in a magnetic disturbance field along, perpendicular, and at 45° to the solar-wind direction. Current systems on the lunar sunlit hemisphere and cavity boundary are also shown. Previous estimates of the deep conductivity, based on inversion of dayside data, are not grossly affected by the presence of the asymmetry. The lunar magnetospheric configuration is expected to be typical of the fields induced by the solar wind in all planetary bodies, e.g., Mercury, that lack atmospheres and internal fields. (auth)

25015 EXPERIMENTAL LIFETIMES AND f-VALUES FOR FOUR LEVELS IN Fe I. Hilborn, R. C.; de Zafra, R. (State Univ. of New York, Stony Brook). Astrophys. J.; 183: No. 1, 347-353(1 Jul 1973).

The mean lifetime of four excited states in Fe I was measured using the Hanle effect (zero-field level crossing). The results for the y $^5D_4$ and z $^5F_5$ levels are in agreement with previous measurements by electron bombardment excitation and optical double resonance. The z $^5F_4$ value corrects a previously reported value and the z $^5D_4$ lifetime is reported for the first time. Oscillator strengths derived from the lifetime measurements are compared with others in the recent literature. (auth)

25016 ELASTIC AND INELASTIC SCATTERING IN ORBITAL CLUSTERING. Baxter, D. C.; Thompson, W. B. (Univ. of California, San Diego, La Jolla). Astrophys. J.; 183: No. 1, 323-336(1 Jul 1973).

A Boltzmann-type equation is used to examine the effects of inelasticity on scattering between particles in Kepler orbits. A Fokker–Planck equation is found which predicts either radial clustering or diffusion. (auth)

25017 GENTLE NEUTRINO SCATTERING AND THE DAVIS EXPERIMENT. Lubkin, E. (Univ. of Wisconsin, Milwaukee). Phys. Lett.; 46A: No. 7, 431-432(11 Feb 1974).

Energy loss from many very soft elastic scatterings of neutrinos could remove the energy from the neutrinos from the Sun. This might be detectable through gross heating of cryogenic preparations by currently available neutrino beams. (auth)

25018 LYMAN'S EMISSION OF SOLAR FLARES. Krivsky, L. (Astronomical Inst., Ondrejov, Czech.); Kurochka, L. N. Bull. Astron. Inst. Czech.; 25: No. 1, 52-61(1974).

A review is given of the present innumerous measurements in the range of the Lα line and in the uv continuum at the time of solar flares. The relation of the flash intensities, recorded in these ranges, to the developmental stages of the flare is discussed. An estimate of the temperature of the flare region, radiating in Lα and of the concentration of hydrogen atoms in their fundamental state is made. It was found that the concentration of the hydrogen atoms and the electron concentration in the investigated parts of the flare are of the same order. The analysis of the Lα radiation of flares leads to the conclusion that in some parts of the flare complex local heating of small flare regions takes place to higher temperature with subsequent heating, which is connected with an emission in Hα as a result of the diffusion of Lα radiation, which comes from the warmer regions of the flare. Some of the physical parameters were computed and their time relations investigated. It was found that the observations of the emission in the Lyman range can yield important facts on the physical and spatial structure of some of the parts of the complex of the whole flare. (auth)

25019 DEVELOPMENT AND SPATIAL STRUCTURE OF PROTON FLARES NEAR THE LIMB AND CORONAL PHENOMENA. VII. Change of Activity Prior to the Proton Flare of September 1, 1971. Krivsky, L. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 25: No. 1, 62-64(1974).

It was again found in the case of the proton flare of Sept. 1, 1971, which occurred beyond the western limb of the solar disk, that the flare activity of the active region increased several days prior to the occurrence of the proton flare. The changes in activity are illustrated by means of the cumulative summation curve of the flare Q-index, which facilitates the determination of the activity trends and their onsets. Since a preceding change in activity trend was observed with a whole series of proton flares in the past, this result has prognostic significance. (auth)

Galaxies

25020 (AD-767367-6-GA) SEARCH FOR OD IN THE GALACTIC CENTER. Cesarsky, D. A.; Crutcher, R. M.; Allen, M. (Owens Valley Radio Observatory, Pasadena, Calif. (USA)). 1973. Contract N00014-67-A-0094-0019. 9p. NTIS $3.00.

The authors have unsuccessfully searched for the delta F = 0 lambda doublet transitions of the doublet Pi($^3/_2$), J = 32 state of OD. The resulting upper limit of the OD/OH column density ratio is 1/400. (GRA)

25021 PLANETARY NEBULAE IN LOCAL GROUP GALAXIES. I. Identifications in NGC 185, NGC 205, and NGC 221. Ford, H. C.; Jenner, D. C.; Epps, H. W. (Univ. of California, Los Angeles). Astrophys. J.; 183: No. 2, L73-L75(15 Jul 1973).

Identifications of planetary nebulae in NGC 185 (4), NGC 205 (12), and NGC 221 (10 are presented. The nebulae were identified by isolating their [O III] λ5007 and Hα emission lines. These nebulae will allow a direct determination of chemical abundances in elliptical galaxies in the Local Group. (auth)

25022 NONLINEAR GASEOUS DENSITY WAVES AND GALACTIC SHOCKS. Shu, F. H. (State Univ. of New York, Stony Brook); Milione, V.; Roberts, W. W. Jr. Astrophys. J.; 183: No. 3, 819-841(1 Aug 1973).

The perturbations in the flow of interstellar gas which result from steady forcing by spiral gravitational fields of various strengths are followed. The density response is quite nonlinear even if the amplitude of the spiral field maintained by the disk stars is only a small fraction of the basic axisymmetric field. An analytical study of the properties of slightly nonlinear flows yields certain results which are qualitatively similar to those found numerically for fully nonlinear flows. Galactic shocks arise naturally, indeed necessarily, if the strength of the underlying spiral gravitational field exceeds a certain critical value. The breadth of the zone of high gas compression depends critically on whether the Doppler-shifted phase-velocity of the stellar density wave is greater than or less than the "effective acoustic speed" of the gas. In the former case, very narrow compression zones result; in the latter, quite broad zones. This distinction may explain why some galaxies have narrow optical arms while others have broad optical arms. In addition, a certain range of values for the intrinsic frequency of the wave gives rise to ultraharmonic resonances which can introduce secondary compressions of the interstellar gas. This result may relate directly to the origin of the Carina spiral feature in the Galaxy as well as to the phenomena of branches, spurs, and feathers which are often seen in external spiral galaxies. (auth)

25023 RATE OF SEPARATION OF MAGNETIC LINES OF FORCE IN A RANDOM MAGNETIC FIELD. Jokipii, J. R. (California Inst. of Tech., Pasadena). Astrophys. J.; 183: No. 3, 1029-1036(1 Aug 1973).

The mixing of magnetic lines of force, as represented by their rate of separation, as a function of distance along the magnetic field, is considered with emphasis on neighboring lines of force. This effect is particularly important in understanding the transport of charged particles perpendicular to the average magnetic field. The calculation is carried out in the approximation that the separation changes by an amount small compared with the correlation scale normal to the field, in a distance along the field of a few correlation scales. It is found that the rate of separation is very sensitive to the precise form of the power spectrum. For a power-law spectrum $\propto k^{-\alpha}$ with $\alpha < 2$, the rate of separation can be quite rapid, and is insensitive to the initial value of the separation. Application to the interplanetary and interstellar magnetic fields is discussed, and it is shown that in some cases field lines, much closer together than the correlation scale, separate at a rate which is effectively as rapid as if they were many correlation lengths apart. In such cases the scale of coherent flux tubes is much less than the correlation scale of the field. (auth)

25024 OSCILLATOR STRENGTHS FOR THE $X^1\Sigma^+$-A^1PI SYSTEM OF CH^+. Yoshimine, M. (IBM Research Lab., San Jose, CA); Green, S.; Thaddeus, P. Astrophys. J.; 183: No. 3, 899-902 (1 Aug 1973).

Oscillator strengths for the $X^1\Sigma^+$-$A^1\Pi$ system of CH^+ were computed to an estimated accuracy of 10 percent from ab initio wave functions. The $f_{v'v''}$ values for the two strongest interstellar lines, λλ4232 and 3957, were found to be, respectively, $f_{00} = 6.45 \times 10^{-3}$ and $f_{10} = 4.31 \times 10^{-3}$. (auth)

25025 MODEL OF THE ORION NEBULA. Zuckerman, B. (Univ. of California, Berkeley). Astrophys. J.; 183: No. 3, 863-869(1 Aug 1973).

It is suggested that the Orion Nebula is a protrusion off the front edge of the dense molecular cloud whose central condensation is the Kleinmann–Low nebula. The present model eliminates the two major difficulties associated with previous models in which the Trapezium is located at the center of an expanding cloud, and it can reasonably account for a number of other observations of the Orion Nebula. The difference in average radial velocity between the Trapezium and the molecular cloud may be due to their mutual gravitational attraction. (auth)

25026 STRUCTURAL CHARACTERISTICS OF THE GALAXY AS A COROLLARY OF THE SCREENING OF THE NEWTONIAN GRAVITATIONAL POTENTIAL. Kolpakov, V. P. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 3, 270-276(1973). (In Russian).

The spiral structure of the Galaxy is explained by the screening of the Newtonian potential. It was assumed that the gravitational potential has the form of the Yukawa–Neumann potential. It is shown that in this case the circular orbits are stable only at radii smaller than critical. The spirals were examined as a locus of the point of matter flowing from a region of instability. The calculated spiral structure satisfactorily agrees with observation. This hypothesis makes it possible also to explain the existence of tails and bridges in the Galaxy. (tr-auth)

25027 PROPERTIES OF THE NUCLEUS OF THE GALAXY NGC 5128. Kuchowicz, B. (Univ. of Warsaw). Urania (Krakow); 43: 274-275(1972). (In Polish).

NGC 5128 is one of the closest radiogalaxies. Its properties in the radio, infrared, and x-ray regions are outlined. (auth)

25028 INDICATIONS OF INTERGALACTIC EXTINCTION EFFECT CONNECTED WITH LARGEST CLUSTERS OF GALAXIES. Toborek, I. (Nicolaus Copernicus Planetarium and Observatory, Chorzow, Poland). Acta Astron.; 22: 67-71(1972).

The present paper is the continuation and conclusion of the papers by Rudnicki (1963) and Brukalska (1969). In these papers the numbers of very distant clusters situated in fields of Zwicky's catalogue containing largest clusters of various types and distance classes is considered. On the whole the results of those two papers and of the present one can be interpreted in favor of the relationship between largest clusters of galaxies and intergalactic extinction. (auth)

25029 SEARCH FOR FLUX DENSITY VARIATIONS IN THE CENTRAL COMPONENTS OF THE EXTENDED EXTRAGALACTIC RADIO SOURCES VIRGO A AND 3C 111. Fanaroff, B. L. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 166: No. 1, 1P-7P(Jan 1974).

Measurements of the λ6 cm and λ11 cm flux densities of the central component and jet of Virgo A and of the central component of 3C 111 were made over a period of 2 yr. Evidence was found of variations in the central component of 3C III and an upper limit set on variations in the nucleus and jet of Virgo A. (auth)

25030 PHOTOMETRY AND SOME FEATURES OF SEYFERT SPIRAL GALAXIES BEYOND THE NUCLEAR REGION. Zasov, A.V.; Lyutyi, V.M. (Shternberg Astronomical Institute, Moscow). Sov. Astron.–AJ 17: No. 2, 169-173 (Sept 1973).

An analysis is made of photoelectric photometry in the U, B, V system of 10 Seyfert galaxies: NGC 1068, 1275, 3227, 3516, 4051, 4151, 5548, and 7469, and Mrk 10 and 79. Most of these Seyferts differ from ordinary spirals of the same morphological type in having a stronger central brightness concentration and a bluer color, especially in the central zone 5″ in diameter (excluding the nucleus itself). There is evidence that the ratio of H I mass to luminosity, and perhaps also the integrated mass/luminosity ratio, is smaller, on the average, for Seyfert galaxies than for normal spirals. If these properties are not transient ones, Seyfert-galaxy nuclei should continue their activity for a period considerably longer than $kT = 10^8$ yr, where T is the age of the galaxy and k is the proportion of Seyferts among ordinary spiral galaxies. (auth)

25031 BACKGROUND RADIO EMISSION OF THE GALAXY. Ariskin, V.I. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR). Sov. Astron.–AJ 17: No. 2, 187-189 (Sept 1973).

The distribution of the background radio emission of the Galaxy at longitudes in the range 20.°3–27.°3 is analyzed for wavelengths from 3.75 cm to 3.5 m. The galactic radio background comprises four main components with distinctive behavior at different wavelengths. (auth)

25032 OBSERVATIONS OF H II REGIONS IN THE MILKY WAY WITH AN Hα FABRY–PEROT SPECTROMETER. Zhidkov, V.F. Sov. Astron.–AJ 17: No. 2, 190-195 (Sept 1973).

The results are reported of observations of H II Milky Way fields in the Hα line, using a Fabry–Perot spectrometer not fed by an optical system. Hα line intensities were observed in the range $(2\text{–}400)\cdot 10^{-6}$ $\mathrm{erg\cdot cm^{-2}\cdot sec^{-1}\cdot sr^{-1}}$ (8–1660 R). Regions of enhanced H II emission were observed in Sagittarius, Scutum, Cygnus, and Lacerta. Strömgren zone of O and B stars are found to be the predominant source of Hα emission in the observed intensity range; the Hα intensity increases with the function $F=100\Sigma_{i=1}^{n}[U_i(Sp)]^3/r_i^2$ summed over such stars in the field of view. The radial velocities of H II regions with $I > 20\cdot 10^{-6}$ $\mathrm{erg\cdot cm^{-2}\cdot sec^{-1}\cdot sr^{-1}}$ ($\simeq 80$ R) agree satisfactorily with the differential galactic rotation. At lower intensities geocoronal hydrogen contributes significantly to the recorded Hα line, and agreement with differential rotation is no longer perceptible. The radial–velocity dispersion in a given field is found to be 43–140 km/sec at half the maximum Hα intensity, 56–200 km/sec at the 0.2 level, and 83–280 km/sec at the 0.05 level. The mean radial–velocity dispersion of the H II regions decreases away from the galactic plane and away from the galactic center along the plane. (auth)

25033 H^- AS A SOURCE OF DIFFUSE INTERSTELLAR BANDS. Snow, T. P. Jr. (Univ. of Washington, Seattle). Astrophys. J.; 184: No. 1, 135-143(15 Aug 1973).

The suggestion that preionization of negative hydrogen ions is the mechanism which produces the diffuse interstellar bands at 4430, 4760, 4890, and 6180 Å can be ruled out on several grounds. Quantum-mechanical calculations are reviewed which, along with the results of experimental work, show no evidence that states exist in H^- at the required levels. It is demonstrated that the Stark effect and collisions are both insufficient to account for the lack of diffuse band absorption in normal stellar atmospheres. Furthermore, the number density of interstellar H^- ions is estimated, and is smaller than the lower limit on the number density of λ4430 absorbers which is required by the observed strength of the band. Finally, observations of the strengths of the four bands are presented, and the apparent lack of good correlations among them is taken as an argument against their having a common source. (auth)

25034 RADIATIVE LIFETIMES AND BAND OSCILLATOR STRENGTHS FOR METAL OXIDES. II. SiO $E^1\Sigma^+$-$X^1\Sigma$. Elander, N.; Smith, W. H. (Princeton Univ. Observatory, NJ). Astrophys. J.; 184: No. 1, 311-315(15 Aug 1973).

The phase-shift method was used to obtain radiative lifetimes for the SiO $E^1\Sigma^+$ state. Electron-beam excitation was used. The lifetimes are essentially constant at 10.5 ± 1.1 ns for $v' = 1-7$. Klein–

Dunham potential curves and Franck–Condon factors were computed, the dipole transition moment variation with vibrational quantum number (internuclear distance) was derived, band f-values are given. The lines of SiO which should be observable in the interstellar medium through this transition are indicated, along with their absorption f-values. (auth)

25035 INTERSTELLAR HYDROGEN IN GALAXIES. Roberts, M. S. (National Radio Astronomy Observatory, Charlottesville, VA). Science; 183: No. 4123, 371-378(1 Feb 1974).

Measurement of the 21-cm line radiation originating from the interstellar neutral hydrogen in a galaxy yields information on the total mass and total hydrogen content of the galaxy. The ratio of these two quantities is correlated with structural type in the sense that the later type galaxies contain a higher fraction of their total mass in the form of interstellar hydrogen. This ratio is one of the few physical parameters known to correlate with structural type. (WDM)

25036 STRUCTURE AND CONTENT OF NGC 205. Hodge, P. W. (Univ. of Washington, Seattle). Astrophys. J.; 182: No. 3, 671-695(15 Jun 1973).

The structure and the content of NGC 205, an elliptical galaxy companion to M31, are studied by means of a series of photoelectric and photographic measurements. Isophotometry of the galaxy provides information on its detailed shape, and was carried out in three colors on the UBV system. The isophotes are elliptical in the center and intermediate regions, but show distortion in the outer regions, probably due to tidal interaction with M31. The ellipticity is found to be variable from the center outward ranging from $\epsilon = 0.35$ in the center to $\epsilon = 0.50$ in the outer parts. The direction of the major axis, θ, is variable, primarily because of the distortion of the isophotes in the outer regions. (WDM)

25037 OBSERVATIONS OF THE BAR OF NGC 4314. Lynds, B. T.; Furenlid, I.; Rubin, J. (Kitt Peak National Observatory, Tucson, AZ). Astrophys. J.; 182: No. 3, 659-669(15 Jun 1973).

Image-tube photographs in blue light and at wavelengths 6563 and 6650 Å are used to obtain colors of the bar of NGC 4314. A nuclear region of about 5″ in size is found to have a strong red continuum. This nucleus is surrounded by a region of extensive hydrogen emission with discrete H II regions identified. The color of the bar is relatively uniform and bluer than the central region. Dust lanes in the bar are found to have extinctions of at least 1.0 mag in the blue. (auth)

25038 DOUBLET-RADIO METHOD AND INTERSTELLAR ABUNDANCES. Nachman, P.; Hobbs, L. M. (Univ. of Chicago, IL). Astrophys. J.; 182: No. 2, 481-487(1 Jun 1973).

The method of doublet ratios, used in obtaining interstellar Na I and Ca II abundances, is generalized to include realistic multiple-cloud cases. Entirely apart from any errors of observation, the simplified velocity distribution used in the method leads to errors in the inferred column densities which are systematic and which can be as large as a factor of ten or more in some practical cases. The D lines of Na I toward ζ Oph illustrate such order-of-magnitude underestimates. (auth)

25039 NOTE ON THE STELLAR CONTENT OF NGC 5195. Spinrad, H. (Univ. of California, Berkeley). Astrophys. J.; 182: No. 2, 381-385(1 Jun 1973).

The stellar content of NGC 5195, investigated and synthesized by scanner spectroscopy, is remarkably similar to that found for M82 by O'Connell. There is a strong contribution by young stars (up to about B5 V), but the spectrum is composite and has late-type features at $\lambda > 5000$ Å. Abundances seem approximately solar. The red color is explainable by dust absorption, with $A_v \simeq 1.8$ mag at the nucleus. Other smaller-scale similarities with M82 are the NGC 5195 nuclear radio emission and the detectable 10-μ infrared excess. (auth)

25040 INTERNAL MOTIONS AND NUCLEAR MASS OF THE SEYFERT GALAXY NGC 7469. Anderson, K. S. (Harvard Coll., Cambridge, MA). Astrophys. J.; 182: No. 2, 369-380 (1 Jun 1973).

Image-tube spectrograms of high resolution were utilized to determine the velocity distribution within the central regions of NGC 7469. The observed velocity curves, some of which were asymmetric, largely reflect the rotation of the galaxy. A component of much smaller amplitude, attributed to radial motions, was also present. If distributed uniformly, the mass interior to 400 pc was about 10^9 $M_\odot$. A central mass condensation in excess of $\sim 10^8$ $M_\odot$ seems to be excluded by the observations. The significance of these mass determinations in relation to models for Seyfert nuclei is discussed. (auth)

25041 EMISSION LINES OF NGC 1068. Eilek, J. A. (Univ. of British Columbia, Vancouver); Auman, J. R.; Ulrych, T. J.; Walker, G. A. H.; Kuhl, L. V. Astrophys. J.; 182: No. 2, 363-368(1 Jun 1973).

The Balmer lines and the forbidden lines of oxygen and nitrogen have been observed in the spectrum of NGC 1068 with an image isocon at 4 Å and 1.3 Å resolutions. The sets of lines are not symmetrical and their averaged profiles are not Gaussian, possibly due to slight wings on the lines. Hα and Hβ have a higher redshift than the forbidden lines, on the order of 100 km s^{-1}. The profile of the Hα–[N II] line fluctuated over the three months of observation, a change apparently due to a change in line width as well as relative strengths. At the highest resolution, there are indications of cloud structure within the nucleus, as seen by others. (auth)

25042 UPPER LIMIT TO THE ANGULAR DIAMETER OF THE NUCLEUS OF NGC 4151. Schwarzschild, M. (Princeton Univ., NJ). Astrophys. J.; 182: No. 2, 357-361(1 Jun 1973).

During the seventh flight of Stratoscope II, a 36-inch balloon-borne telescope, five photographs of the nucleus of the Seyfert galaxy NGC 4151 as well as four equivalent photographs of a comparison star were obtained. These photographs show high definition and are well exposed. From a densitometric analysis a safe upper limit to the half-intensity diameter of the nucleus of 0.08″ is derived. This new upper limit is less than half the upper limit previously determined. (auth)

25043 POSSIBLE SYSTEMATIC REDSHIFTS IN A CHAIN OF GALAXIES. Gregory, S. A.; Connolly, L. P. (Univ. of Arizona, Tucson). Astrophys. J.; 182: No. 2, 351-355(1 Jun 1973).

Redshifts are reported for two groups of galaxies. Although these two groups have previously been assigned to the same cluster, their redshifts indicate that they are not associated. A systematic variation of redshifts is found across the chain of one of these groups, Abell 2247, and several interpretations are discussed. (auth)

25044 Ca I ABSORPTION AND THE ELECTRON DENSITIES IN INTERSTELLAR CLOUDS. White, R. E. (Hale Observatories, Pasadena, CA). Astrophys. J.; 183: No. 1, 81-86 (1 Jul 1973).

New photoelectric detections of interstellar Ca I absorption in 10 stars, combined with new and existing Ca II data, yield an average Ca I to Ca II ratio of 6.2×10^{-3}. It is argued that the Ca I lines and most, if not all, the Ca II lines are formed in interstellar clouds. For cloud conditions, the Ca I to Ca II ratio and the assumption of ionization equilibrium give $n_e \sim 0.09$ cm^{-3}, although the average for all clouds might be as small as 0.03 cm^{-3}. Such electron densities require that hydrogen be partially ionized, imply that both Ca and Na are underabundant in interstellar clouds, and suggest that the important cooling elements are also underabundant. (auth)

25045 REEVALUATION OF THE DIATOMIC PROCESSES LEADING TO CH AND CH$^+$ FORMATION IN THE INTERSTELLAR MEDIUM. Smith, W. H. (Princeton Univ., NJ); Liszt, H. S.; Lutz, B. L. Astrophys. J.; 183: No. 1, 69-80(1 Jul 1973).

The direct radiative recombination coefficients for CH and CH$^+$ were reevaluated using recent atomic and molecular data in a purely quantum-mechanical matrix-scattering formalism. The resulting coefficients were appreciably smaller than the classical values of Bates. Indirect radiative recombination can occur through preassociation with rates comparable to those found for CH and CH$^+$ for the direct process. Photodestruction for CH and dissociative recombination for CH$^+$ appear dominant in limiting their respective abundances. Calculated column densities fall short of the observed column densities in ζ Oph, although purely diatomic processes could account for about one-quarter of the CH$^+$ if the rate for dissociative recombination has been overestimated. (auth)

25046 DUST IN THE FILAMENTS OF M82. Mathis, J. S. (Univ. of Wisconsin, Madison). Astrophys. J.; 183: No. 1, 41-47(1 Jul 1973).

Several workers have proposed that the filaments in M82 radiate by the scattering of light from a central source by dust. The principal objection to this hypothesis is that the polarization and intensity of scattered light, relative to the central source, appear almost independent of wavelength. This paper, however, shows that a reasonable mixture of particles can in fact produce the observed properties if the central source suffers a modest reddening by dust immediately around it. On this picture the dust in the halo of M82 is optically thin, but the net velocity of approach (relative to the center) of many areas is due to the favoring of particles on the near side by the forward-throwing phase function of the dust. Calculations are presented for one mixture of dust sizes; but this mixture is not unique, and the optical properties of the dust cannot be determined from the scattered intensity. (auth)

25047 PHOTOMETRIC STUDY OF MARKARIAN GALAXIES. Weedman, D. W. (Vanderbilt Univ., Nashville). Astrophys. J.; 183: No. 1, 29-39(1 Jul 1973).

Photoelectric UBV observations were obtained for 92 Markarian galaxies and an additional five Seyfert galaxies to study the colors of the continuous spectra in these objects. A total of 28 Seyfert galaxies, 42 other galaxies with bright blue nuclei, and 27 diffuse galaxies were included. Multiaperture observations are presented for seven of these galaxies. It was found that galaxies spectroscopically classified as Seyfert galaxies because of broad nuclear emission lines have UBV colors corresponding to nonthermal continua, but the numerous Markarian galaxies with bright nuclei having narrow emission lines do not have such colors; instead, the ultraviolet continua of these galaxies apparently arise from hot stars. New spectroscopic and photographic observations are also presented for some Markarian galaxies of particular interest, including Markarian 3 and 205. (auth)

25048 MEASUREMENT OF THE RATE CONSTANT FOR THE REACTION $D^+ + H_2 \to HD + H^+$. Fehsenfeld, F. C.; Dunkin, D. B.; Ferguson, E. E.; Albritton, D. L. (NOAA Environmental Research Labs., Boulder, CO). Astrophys. J.; 183: No. 1, L25-L26(1 Jul 1973).

It has recently been pointed out that the reaction $D^+ + H_2 \to HD + H^+$ can lead to enhanced HD/H_2 ratios in the interstellar medium if the rate constant is sufficiently large. The rate constant was measured and found to be 1.0×10^{-9} cm^3 s^{-1}, and independent of temperature from 80° to 278° K. (auth)

25049 CHEMI-IONIZATION IN INTERSTELLAR CLOUDS. Dalgarno, A. (Harvard Coll. Observatory, Cambridge, MA); Oppenheimer, M.; Berry, R. S. Astrophys. J.; 183: No. 1, L21-L24(1 Jul 1973).

It is pointed out that the chemiionization reaction $CH + O \to HCO^+ + e$ is a source of positive ions and free electrons in interstellar clouds and that carbon monoxide is produced efficiently by the sequence of chemiionization and dissociative recombination. (auth)

25050 RATE OF FORMATION OF INTERSTELLAR MOLECULES BY ION–MOLECULE REACTIONS. Watson, W. D. (Univ. of Illinois, Urbana). Astrophys. J.; 183: No. 1, L17-L20(1 Jul 1973).

Ion–molecule reactions involving H_2 and H_3^+ in the interstellar medium are examined when hydrogen is mainly in molecular form. Most small molecules except H_2 and CH^+ can be formed as a result of these reactions. For the ionization rate due only to the observed high-energy cosmic rays, the rate of molecule formation is comparable with or exceeds upper limits for previously considered processes at particle densities $\lesssim 10^4$ cm^{-3}. Due to the widespread abundance of H_2, ion–molecule reactions with H_2 and H_3^+ can be the chief formation process for small interstellar molecules in a large fraction of the interstellar gas. (auth)

25051 STUDIES OF BLUE OBJECTS AT HIGH GALACTIC LATITUDES. III. Faint Blue Objects in the Field of BD + 15°2469. Barbieri, C.; Benvenuti, P. (Astronomical Observatory, Padua). Astron. Astrophys., Suppl. Ser.; 13: No. 2, 269-291(Feb 1974).

A list is given of 306 stellar or semistellar objects with negative U–B color index found on the third field (part of the Virgo Cluster of Galaxies) of the Asiago Survey of Blue Objects at High Galactic Latitudes. Comparing this field with the previous two, a remarkably higher number of small ultraviolet galaxies is found, therefore presumably associated with the Virgo Cluster. In a second table several ultraviolet condensations found on bright galaxies of the field are listed. Individual objects of particular interest are also described. (auth)

Cosmology

Refer also to abstract 25945.

25052 GRAVITATIONAL INSTABILITY IN A STATIC UNIVERSE AND ANGULAR MOMENTUM OF GALAXIES. Simon, R. (Univ., Lige). Bull. Cl. Sci., Acad. Roy. Belg.; 59: No. 8, 735-749(1973).

Gravitational instability arising from thermal fluctuations in a static Universe is considered in an extrapolation of a weakly nonlinear approximation, to calculate the mean square angular momentum of protogalaxies at the critical time at which these protogalaxies detach themselves from the primeval homogeneous medium. The mean angular momentum of a given volume, containing in the mean a mass M, and the mean angular momentum of a given mass M, are shown to be quite different. It is suggested that it is the latter which should be compared with the observed angular momentum of galaxies. A numerical application shows that such a picture cannot account for the observed angular momentum of the Galaxy and at the same time for the existence of dwarf galaxies. A simple calculation suggests however that tidal interactions arising between neighbouring protogalaxies after the critical time of detachment would easily account for the observed angular momentum of spiral galaxies, if these interactions take place before the Universe is set in a state of fully developed expansion. (auth)

25053 DISCREPANT REDSHIFTS OF QSOs IN CLUSTERS OF GALAXIES AND A CLOSE QSO PAIR. Hazard, C.; Jauncey, D. L.; Sargent, W. L. W.; Baldwin, J. A.; Wampler, E. J. (Cambridge Univ., Eng.). Nature (London); 246: No. 5430, 205-208 (23 Nov 1973).

Reference is made to the controversy concerning whether QSO redshifts are cosmological in origin or whether QSOs are more local objects. The strongest direct evidence for the cosmological hypothesis is provided by observations of a number of QSOs that have been shown to have redshifts agreeing to within about 1% with the redshifts of apparently associated clusters of galaxies. These QSO-cluster associations have all been found in searches restricted to QSOs with $Z < 0.36$ since it is only for such low values of Z that the associated galaxies would be readily visible; but by assuming at the outset that the redshifts are cosmological these investigations do not test the noncosmological hypothesis. For the past several years the authors have been attempting to carry out a study of QSOs in clusters or groups which would be free from this objection, and some of the preliminary findings are here reported. It is stated that the most convincing case for a QSO-cluster association is provided by 4C24.23, optical spectra of which were obtained using the 200 inch telescope at Palomar. It is concluded that from an examination of galaxy counts it will be extremely difficult to establish a non-cosmological contribution to the QSO redshifts on the basis of an association with clusters of galaxies unless additional information can be obtained to rule out the possibility of chance associations. The detection near 4C11.50 of a possibly physically associated pair of QSOs seems, however, to offer a more promising approach. In order to establish beyond doubt the existence of associations of QSOs will require many more examples, preferably with more than two members. It may be, however, that a significant test of the nature of QSO redshifts is at last in sight. (UK)

25054 CLOSE PAIRS OF QSOs. Bahcall, J. N.; Woltjer, L. (Princeton Univ., NJ). Nature (London); 247: No. 5435, 22-23 (4 Jan 1974).

It has been suggested that the observation of close pairs of QSOs with very different redshifts provides support for the noncosmological explanations of the redshifts. It is shown in this note, however, that the pairs observed so far may be explained as random coincidences. So far two close pairs of QSOs have been observed. (UK)

25055 WHY THE SKY IS DARK AT NIGHT. Harrison, E. R. (Univ. of Massachusetts, Amherst). Phys. Today; 27: No. 2, 30-33; 35-36(Feb 1974).

It is shown that the sufficient condition for resolving the bright-sky (Olbers') paradox in a static universe is that the thermodynamic time scale is much larger than the luminous lifetime of the stars, and in general this is also true of the static steady-state model, the expanding models, and possibly the expanding steady-state model. (WDM)

25056 POSSIBLE NEW TEST OF THEORIES OF GRAVITATION. Cohen, J. M. (Univ. of Pennsylvania, Philadelphia); Reinhardt, M.; Rosenblum, A. Phys. Lett.; 46A: No. 4, 269 (31 Dec 1973).

A new test of theories of gravitation is proposed which is based on the general relativistic dragging of inertial frames. This might lead to observable period differences in pulses produced near the surface of neutron stars. (auth)

25057 INERTIA SPACE OF LINEAR FIELD THEORY. Scherrer, W. Helv. Phys. Acta; 46: No. 2, 235-252(15 Aug 1973). (In German).

The development of linear field theory leads to the conclusion that the cosmological structure of the world can not be the result of forces, but conversely it exists beforehand, in order to be able to define forces at all. In this way, therefore, a cosmological structure, as "inertia space", is taken as a basis and following from this, linear field theory is built up. (tr-auth)

25058 GRAVITATIONAL FIELD OF A UNIFORMLY ROTATING SPHERE IN THIRD APPROXIMATION. McCrea, J. D. (University Coll., Dublin). Proc. Roy. Irish Acad., Sect. 73A: No. 4, 25-45(1973).

A model Universe is constructed which represents a sphere rotating with constant angular velocity. The metric satisfies Einstein's equations with an error of order k^4, where k may be identified with the mass/radius ratio of the sphere ($k = 10^{-6}$ for a body like the Sun). Alternatively, if the metric is accepted as exact, it can be said that the field equations are satisfied accurately, but that outside the sphere there is, instead of a perfect vacuum, a residual energy tensor or "dirt" with components which bear to the density of the sphere a ratio of order k^3. Equations for the equatorial geodesics are calculated on the basis of this exact metric. A comparison is made with the results of Lense and Thirring (Phys. Z.; 19: 156(1918)) and with the Kerr metric. (auth)

25059 MAXIMUM-LIKELIHOOD ESTIMATION OF THE NUMBER-FLUX-DENSITY DISTRIBUTION OF RADIO SOURCES IN THE PRESENCE OF NOISE AND CONFUSION. Murdoch, H. S. (Cornell Univ., Ithaca, NY); Crawford, D. F.; Jauncey, D. L. Astrophys. J.; 183: No. 1, 1-13(1 Jul 1973).

The application of the method of maximum likelihood to the determination of the slope of the number—flux-density relationship is extended to include the presence of experimental errors in the flux-density measurements. It is shown that these experimental errors have a significant effect on the number counts at higher ratios of flux density to error than is often recognized. The case of noise-limited flux-density measurements is treated in some detail, and it is found that, provided the lower limit of a survey is chosen to be at least five times the rms noise, the enhancement in the source density as a function of flux density can be readily calculated. For the case of significant confusion errors in the flux-density measurements the importance of a Monte Carlo approach is emphasized. Several methods that have been used previously are discussed and a number of shortcomings noted. (auth)

25060 INTERACTING MATTER AND RADIATION IN HOMOGENEOUS ISOTROPIC WORLD MODELS. Knight, W. R.; Bergmann, O. (George Washington Univ., Washington, DC). Int. J. Theor. Phys.; 9: No. 1, 47-54(Jan 1974).

Transitions between two or more fluids may result in changes of the total amount of radiation in the Universe without violating overall energy conservation. Special rate equations for such processes are discussed, for which the radius of the Universe as a function of time can be found by numerical integration of a single differential equation, and the radiation density can then be easily obtained, although it must be verified as positive for all times. The integrations are carried out and reported here for the simplest rate equation for two fluids for various values of the initial mass of one fluid, the transition rate, and the cosmological constant. (auth)

Planetary Phenomena

25061 (AD-767308-0-GA) CALCULATIONS OF EXPECTED PROTON FLUENCES FOR A FLYBY OF JUPITER. Final Report. Butler, J. W. (Naval Research Lab., Washington, D. C. (USA)). Sep 1973. 108p. (NRL-MR-2651). NTIS $4.25.

The Naval Research Laboratory was requested to study the problem of radiation survivability for the Jupiter—Saturn spacecraft beginning with the 1976 launch. This report describes in some detail one phase of the survivability project: calculations of proton fluence spectra that might be expected from Jupiter's trapped radiation on the basis of the best trapped radiation models currently available. (GRA)

25062 (BNL-18580) RADIOACTIVE RARE GASES AND TRITIUM IN THE SAMPLE RETURN CONTAINER, AND THE ^{37}Ar AND ^{39}Ar DEPTH PROFILE IN THE APOLLO 16 DRILL STEM. Stoenner, R. W.; Davis, R. Jr.; Bauer, M. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 33p. Dep. NTIS $3.75.

The gas was extracted from the sample return container from the Apollo 16 and 17 missions by adsorption on charcoal and activated vanadium metal. The hydrogen, argon, and radon were separated and counted to give the tritium, ^{37}Ar, ^{39}Ar, and ^{222}Rn activities. The tritium and argon activities observed could be explained by diffusive losses of these gases from the fine material in the container. There was no excess tritium present in the Apollo 17 containers that could be attributed to solar tritons remaining from the intense flare of August 4, 1972. The ^{222}Rn observed in the sample return container was interpreted as an emanation product from lunar fines and an emanation yield of 1×10^{-4} was calculated. This yield is consistent with the low radon content observed in the lunar atmosphere. The tritium, ^{37}Ar, ^{39}Ar, and ^{222}Rn activities and the K, Ca, Ti, Fe, and Mn contents were measured on a set of samples from the Apollo 16 deep drill stem at depths from 83 to 343 g/cm^2. The ^{37}Ar and ^{39}Ar activities combined with similar measurements at more shallow depth by Fireman and associates (SAO) give the complete activity profile in the lunar regolith. Since ^{37}Ar is produced mainly by the ^{40}Ca(n,α)^{37}Ar reaction it is possible to determine the neutron production rate in the regolith as a function of the depth. The ^{222}Rn extracted from the samples by vacuum melting was found to be lower than expected in some samples based upon their uranium contents. The hydrogen and helium contents of the drill stem samples were measured and found to be relatively uniform with depth in contrast to similar measurements on Apollo 15 and 17 drill stems. The H/He atom ratio was higher than the accepted solar-wind value by a factor of two, possibly due to water contamination. (auth)

25063 DETECTION OF RADON EMISSION AT THE EDGES OF LUNAR MARIA WITH THE APOLLO ALPHA-PARTICLE SPECTROMETER. Gorenstein, P.; Golub, L.; Bjorkholm, P. (American Science and Engineering, Cambridge, MA). Science; 183: No. 4123, 411-413(1 Feb 1974).

The distribution of radioactive ^{210}Po, a decay product of ^{222}Rn, shows enhanced concentrations at the edges of lunar maria. Enhancements are seen at the edges of Mare Fecunditatis, Mare Crisium, Mare Smythii, Mare Tranquillitatis, Mare Nubium, Mare Cognitum, and Oceanus Procellarum. The observation is indicative of the transient emission of radon gas from the perimeters of lunar maria. (auth)

25064 MERCURY: DOES ITS ATMOSPHERE CONTAIN WATER? Thomas, G. E. (Univ. of Colorado, Boulder). Science; 183: No. 4130, 1197-1198(22 Mar 1974).

The atmosphere of Mercury, like that of the Moon, is maintained in an extremely tenuous minimum state by weak solar—wind accretion and radioactive decay processes, and depleted by strong removal mechanisms. Unlike the Moon, it has a high daytime surface temperature that promotes the production of water vapor, which may be the dominant atmospheric constituent derived from solar-wind protons. (auth)

25065 POLARIZED MAGNETIC FIELD FLUCTUATIONS AT THE APOLLO 15 SITE: POSSIBLE REGIONAL INFLUENCE ON LUNAR INDUCTION. Schubert, G. (Univ. of California, Los Angeles); Smith, B. F.; Sonett, C. P.; Colburn, D. S.; Schwartz, K. Science; 183: No. 4130, 1194-1197(22 Mar 1974).

High-frequency (5 to 40 millihertz) induced lunar magnetic fields, observed at the Apollo 15 site near the southeastern boundary of Mare Imbrium and the southwestern boundary of Mare Serenitatis, show a strong tendency toward linear polarization in a direction radial to the Imbrium basin and circumferential to the Serenitatis basin, a property that could be indicative of a possible regional influence on the induction. (auth)

25066 LUNAR SURFACE: IDENTIFICATION OF THE DARK MANTLING MATERIAL IN THE APOLLO 17 SOIL SAMPLES. Pieters, C. (Massachusetts Inst. of Tech., Cambridge); McCord, T. B.; Charette, M. P.; Adams, J. B. Science; 183: No. 4130, 1191-1193(22 Mar 1974).

Evidence indicates that Apollo 17 sample 74001, a soil consisting of very dark spheres, is composed almost entirely of the dark mantling material that covers a large region of the southeastern boundary of Mare Serenitatis. Other Apollo 17 samples contain only a component of this material. The underlying basalt in the Taurus—Littrow valley appears to be an extension of material forming the low-albedo ring around part of Mare Serenitatis and much of the surface of Mare Tranquillitatis. The surface of this basalt region is spectrally distinct from areas with dark mantling material. These results are derived from telescopic and laboratory measurements of the optical properties of lunar soil. Digital vidicon color images are used to map the extent of these material units in the Taurus—Littrow region. (auth)

25067 COMPOSITION OF METALLIC IRON AND SOME COEXISTING PHASES ON THE SAMPLES FROM HIGHLAND LUNAR REGION RETURNED BY AUTOMATICAL STATION

LUNA-20. Ivanov, A. V.; Il'in, N. P.; Loseva, L. E.; Senin, V. G. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya; No. 12, 1782-1792(Dec 1973). (In Russian).

The composition of metallic inclusions and a number of peculiar coexisting phases in the particles of highland regolith "Lunar-20" samples is investigated by the microprobe technique. The composition of metallic phases is regarded to kamacite and taenite, the latter consisting up to 19% of Ni. The troilite and schreibersite are observed in intergrowths with the metallic phase. The size and composition of metallic inclusions and the type of mineralogical ensemble are in accordance with the hypothesis of meteoritic genesis of the metallic inclusions under investigation. The intensive alteration of primary lunar rocks as well as the presence of metallic inclusions of probable meteoritic origin in their composition is the base of suggestion that the brecciation, metal impregnation as well as partial alteration of these rocks is to be considered as the result of the single process. (auth)

25068 IN-SITU MEASUREMENT OF THE RATE OF ^{235}U FISSION INDUCED BY LUNAR NEUTRONS. Woolum, D. S.; Burnett, D. S. (California Inst. of Tech., Pasadena). Earth Planet. Sci. Lett.; 21: No. 2, 153-163(Jan 1974).

The depth profile of the neutron-induced fission rate of ^{235}U was directly measured to a depth of 350 g/cm^2 by the Apollo 17 Lunar Neutron Probe Experiment. The fission rate rises sharply from the surface to a broad maximum from 110 to 160 g/cm^2 and drops off at greater depths. The shape of theoretical depth profile of Lingenfelter et al. fits the measured capture rates well at all depths. The absolute magnitude of the experimental fission rates is $(11 \pm 17)\%$ lower than those calculated theoretically. The excellent agreement between theory and experiment implies that conclusions drawn previously by interpreting lunar sample data with the theoretical capture rates will not require revision. In particular, lunar surface processes, rather than uncertainties in the capture rates, are required to explain the relatively low neutron fluences observed for surface soil samples compared to the fluences expected for a uniformly mixed regolith. (auth)

25069 SURFACE HISTORY OF LUNAR SOIL AND SOIL COLUMNS. Fleischer, R. L.; Hart, H. R.; Giard, W. R. (General Electric Co., Schenectady, NY). Geochim. Cosmochim. Acta; 38: No. 3, 365-380(Mar 1974).

Measurements of cosmic-ray track densities are presented for soil samples from Apollo 15, 16, and 17. Median track densities are used to infer total effective exposure times within ~15 cm of the lunar surface. Minimum track densities are used to derive the time of the last impact-produced rearrangement of soil grains. For samples from near various craters ages are derived of 40 m.y. for St. George, 6(±3) m.y. for S. Ray, 25 to 90 m.y. for Plum, and 20 to 35 m.y. for Shorty. The material of 15003, the Apollo 15 deep core at depths of 120 to 160 cm, is inferred to have been deposited at an average rate of ≥ 0.35 cm/m.y. The Apollo 16 core at 41 to 47 cm depths, 60007, appears to be well mixed and was covered up by deposition at >0.3 cm/m.y. for the next few m.y. after its deposition. (auth)

25070 HELIUM IN THE MARTIAN ATMOSPHERE. Thermal Loss Considerations. Levine, J. S.; Keating, G. M.; Prior, E. J. (National Aeronautics and Space Administration, Greenbelt, MD). Planet. Space Sci., 22: No. 3, 500-503(Mar 1974).

Helium concentrations in the Martian atmosphere are estimated assuming that the helium production on Mars, comparable to its production on Earth, via the radioactive decay of uranium and thorium, is in steady state equilibrium with its thermal escape. Although nonthermal losses would tend to reduce the estimated concentrations, these concentrations are not necessarily an upper limit since higher production rates and/or a possibly lower effective exospheric temperature over the solar activity cycle could increase them to even higher values. The computed helium concentration at the Martian exobase (200 km) is 8×10^6 atoms cm^{-3}. Through the lower exosphere, the computed helium concentrations are 30 to 200 times greater than the Mariner-measured atomic hydrogen concentrations. It follows that helium may be the predominant constituent in the Martian lower exosphere and may well control the orbital lifetime of Mars-orbiting spacecraft. The estimated helium mixing ratio is greater at the Martian turbopause than at the terrestrial turbopause, and the helium column density in the lower Martian atmosphere may be comparable to that on Earth. (auth)

25071 OBLIQUE STRUCTURE OF JUPITER'S BOW SHOCK. Greenstadt, E. W. (TRW Systems Group, Redondo Beach, CA). J. Geophys. Res.; 78: No. 25, 5813-5817(1 Sep 1973).

The Pioneer 10 flyby trajectory is related to the nominal Jovian bow shock and the analogy between the Earth's and Jupiter's shocks is extended to include some structural features. (WDM)

25072 ISOTOPIC COMPOSITION OF CARBON AND HYDROGEN IN SOME APOLLO 14 AND 15 LUNAR SAMPLES. Friedman, I.; Hardcastle, K. G.; Gleason, J. D. J. Res. U. S. Geol. Surv.; 2: No. 1, 7-12(1974).

Isotopic composition of carbon and hydrogen in some Apollo 14 and 15 lunar samples was determined by use of a newly constructed combustion line that yields low blanks for CO_2 and H_2. The results from combustion of fines and breccia from Apollo 14 lunar samples and of fines, breccia, and basalt from Apollo 15 were compared with data obtained by heating samples in vacuo to over 1,350°C. The two techniques gave similar results. Total carbon in the fines ranged from 51 to 110 p/m with a δC^{13} of +12 to −8 per mil (parts per thousand) PDB. The breccias contain 22 to 50 p/m carbon with a δC^{13} of −21 to −25 per mil. The crystalline rock (sample 15555) has a carbon content of about 7 p/m and a δC^{13} of −28 per mil. The total hydrogen in the fines ranges from 66 to 120 p/m with a $(D/H) \times 10^{-6}$ of 39 to 90. The breccias contain 8 to 38 p/m H_2 with a $(D/H) \times 10^{-6}$ of 103 to 144. The crystalline rock contains about 2 p/m H_2 with a $(D/H) \times 10^{-6}$ of about 140. Arguments are presented to show that the contamination by Earth materials is not as serious a problem as has been proposed by previous authors. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

25073 (AD-763699) DEFENSE NUCLEAR AGENCY REACTION RATE HANDBOOK, SECOND EDITION. Final Report. Bortner, M. H.; Baurer, T. (General Electric Co., Philadelphia, Pa. (USA)). Mar 1972. Contract DASA01-70-C-0082. 103p. (DNA-1948-H). NTIS $21.00.

The recovery of the atmosphere, following its disturbance by any of several natural or manmade events of the magnitude of a solar-flare impingement or a nuclear burst, may be characterized in terms of certain extremely important chemical and physical processes. It is the purpose of this Handbook to provide the best available detailed information concerning both chemical and physical mechanisms of the sort indicated above. The following topics are discussed: Atmospheric structure; Fluid mechanics and aeronomy; Energy balance in the upper atmosphere; The disturbed atmosphere; Chemical kinetics of the disturbed atmosphere; Methods of gathering data; Basic energy-level and equilibrium data; The kinetics of atmospheric radiative processes in the infrared; Photochemical processes; Kinetics of low-energy electron collision processes and high-energy heavy-particle collisional processes; Charged-particle recombination processes; Electron attachment and detachment; Ion-neutral reactions; Neutral reactions; Excitation and deexcitation processes; Electron collision frequencies and radiofrequency absorption; and Deionization solutions. (GRA)

25074 (AD-763749) DETERMINATION OF THE VIBRATIONAL TEMPERATURE OF N_2 IN THE E AND F ATMOSPHERIC REGIONS. Bortner, M. H.; Baurer, T. (General Electric Co., Philadelphia, Pa. (USA)). Jul 1972. 44p. (DNA-3092-T). NTIS $3.00.

Summarizing the results of this effort, the vibrational energy content of atmospheric N_2 was determined through numerical integration of the time-dependent species continuity equations and the species equation of motion. Generalized diffusion through the nonuniform thermosphere was included. Sources of excitation included the reaction of atomic nitrogen with NO, and the quenching of O (singlet D). Loss mechanisms used in the calculations were VT energy transfer to atomic oxygen, and VV exchange to CO_2. The results predict a vibrational temperature of about 300 K at 100 km altitude, and less than 1500 K at 300 km, both at noontime, in good agreement with values derived from positive-ion data for a quiet atmosphere and with recent rocket-probe measurements. (auth)

25075 (AD-765936-0) INFLUENCE OF SOLAR MAGNETIC SECTOR STRUCTURE ON TERRESTRIAL ATMOSPHERIC VORTICITY. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Jul 1973. Contract N00014-67-A-0112-0068. 35p. (SU-IPR-530). NTIS $3.75.

The solar magnetic sector structure has a sizable and reproducible influence on tropospheric and lower stratospheric vorticity. The average vorticity during winter in the northern hemisphere north of 20N latitude reaches a minimum approximately one day after the passing of a sector boundary, and then increases during the following two or three days. The effect is found at all heights within the troposphere, but is not prominent in the stratosphere, except at the lower levels. No single longitudinal interval appears to dominate the effect. (GRA)

25076 (AD-766222-4) RESEARCH OF AEROPHYSICS INSTITUTE FOR STRATEGIC TECHNOLOGY. Semiannual Technical Summary for Period Ending 28 February 1973. Bloom, M. H. (Polytechnic Inst. of Brooklyn, N.Y. (USA)). 30 Jun 1973. Contract DAHCO4-69-C-0077. 24p. (PIBAL-73-A; AROD-8677-38-P). NTIS $3.25.

The report contains a description of the technical problem areas and accomplishments achieved during the reporting period. In addition, a complete list of publications, presentations, lectures, etc. is included and the personnel associated with the program are listed. The research projects are in the general subject areas of fluid and plasma dynamics. (GRA)

25077 (AD-766240-6) EMPIRICAL MODEL OF THE POLAR IONOSPHERE. Air Force Surveys in Geophysics. Elkins, T. J. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 23 May 1973. 151p. (AFCRL-TR-73-331; AFCRL-AFSIG-267). NTIS $4.75.

Four separate articles are collected which deal with the construction of empirical models of the polar ionosphere. The particular emphasis in these articles is towards the radio propagation application of the models. Numerical models of the vertical electron density profiles on the topside and bottomside of the F region are developed, and a model for sporadic E is included. Special attention is devoted to features which are characteristic of the polar ionosphere-auroral effects, the trough, and magnetospheric cleft regions. The models are constructed specifically for convenience in computer programming, and in fact, all aspects of the models contained in this report are available in the form of Fortran computer programs. (auth)

25078 (AD-766978-1) DIURNAL VARIATIONS IN THE D REGION DURING PCA EVENTS (42). Swider, W.; Keneshea, T. J. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 28 Aug 1973. 49p. (AFCRL-TR-73-545). NTIS $4.50.

Extensive computations have been performed in order to simulate the diurnal behavior of the D region during PCA events. Computations using 98 reactions with only NO+ and O2+ as positive ions apparently yield too much 30 MHz riometer absorption. Nevertheless, the argument of Swider et al (1971) is substantiated that this simple positive ion chemistry is sufficient regarding the deduction of the nighttime electron concentration profile. Expansion of the computer code to 195 reactions, including species like $(H_3O + H_2O)n$ provides more reasonable results as far as the positive ion chemistry is concerned since such ions are known to exist in the D region. However, too few electrons appear to be generated in the 50 to 65 km region, which is indicative of insufficient knowledge of the negative ion chemistry. (GRA)

25079 (SLA-73-576) ESTIMATION OF PARTICLE SIZE DISTRIBUTIONS. Davis, J. A.; Davenport, S. M.; Biggs, F. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1974. Contract AT(29-1)-789. 25p. Dep. NTIS $3.25.

A means of estimating the distribution of particle sizes in certain regions of the atmosphere was investigated. A ray, to which the particles are opaque, was passed through the region and the cross sections of those intersected were measured. Under certain assumptions the distribution of cross-section diameters was written as an integral equation involving the underlying size distribution. The measurement data was used to estimate the distribution of cross sections and the integral equation then numerically unfolded to yield an estimate of the particle size distribution. The process was simulated for several distributions. (auth)

25080 OI λ1304 AND λ1356 EMISSIONS IN AURORAE. Strickland, D. J.; Rees, M. H. (Univ. of Colorado, Boulder). Planet. Space Sci.; 22: No. 3, 465-481(Mar 1974).

An altitude profile of the λ3914 emission of N_2^+ measured in an aurora by two rocket-borne spectrometers has been used to compute height-intensity profiles of the OI radiations at λ1304 and λ1356. Comparison of predictions with observations shows that the shape of the altitude profiles can better be reproduced by assuming a Doppler frequency profile rather than a Voigt profile in the radiative transfer computations. There are serious discrepancies between the observed and predicted intensity maxima for both oxygen features that could be due to the particular value for the cross sections adopted for excitation of oxygen by electron impact. Calculations have also been carried out for two model aurorae characterized by widely differing primary electron spectra, and find that simultaneous zenith-nadir measurements would not only be useful for specifying the nature of the precipitating electron flux, but also for further testing important assumptions made in the radiative transfer calculations. (auth)

25081 SELF-CONSISTENT THEORY OF TRIGGERED VLF EMISSIONS. Nunn, D. (King's Coll., London). Planet. Space Sci.; 22: No. 3, 349-378(Mar 1974).

This work is a study of the nonlinear interaction of cyclotron resonant electrons with a narrow band whistler wave travelling along a magnetospheric duct. The nonlinear equations of motion are investigated and it is found that resonant electrons become stably trapped in the wave, and because of the magnetic field inhomogeneity such particles undergo a steady change in energy and magnetic moment. Extensive computations of the nonlinear resonant particle current are made for a wide variety of choices for the wave field. Invariably it was found that the current was due chiefly to the displacement in energy of a bunch of stably trapped particles. A self-consistent computer program is constructed which follows in detail the time development of a morse pulse as it crosses the Equator. The program uses a model prescription for the resonant particle current as a function of field that assumes that trapped particles are the dominant contributors. With a suitable choice of parameters it was found that the model produced long emissions of rising frequency very similar in appearance to those in reality. One run produced a steep faller, also very much like those observed. Finally a very long pulse was put into the model and slow pulsations were obtained in amplitude similar to those noted by Bell and Helliwell (J. Geophys. Res.; 76: 8414(1971)). Although the self-consistent program suffers from an inability to handle large amplitude sideband waves, and has to be very heavily smoothed, the results show convincingly that the nonlinear trapping of electrons in an inhomogeneous medium is fully able to account for triggering instability. (auth)

25082 RESPONSE OF DAYSIDE THERMOSPHERE TO AN INTENSE GEOMAGNETIC STORM. Allan, R. R. (Royal Aircraft Establishment, Farnborough, Eng.). Nature (London); 247: No. 5435, 23-25(4 Jan 1974).

Increases in the density of the neutral thermosphere associated with geomagnetic activity have been noted. Although the thermosphere will not be in equilibrium, and acceleration by electrodynamic forces may be involved, the increased density must reflect additional heating. The heating appears to be greater at high latitudes and, for larger disturbances, sometimes much greater. It also seems to be slightly greater on the night side, but possibly showing an opposite trend for larger disturbances. The low g accelerometer calibration system (LOGACS) experiment carried on an attitude–controlled Agena vehicle launched by the US Air Force on May 22nd 1967 provided a unique opportunity to determine the response to an intense storm, and observations are discussed. The accelerometer provided values of atmospheric density with an estimated accuracy better than 10% and a time resolution of 1 sec. It was found that the density in the northern night side auroral regions increased with the onset of geomagnetic activity, whereas the density in the northern day side auroral regions initially decreased. An independent analysis was made of the LOGACS data, concentrating on the day side, for which the data were more complete and contained the most clearly defined structures. Although the gross structure of the response has a wave-like pattern, it is not a propagating wave. It seems possible that the heating is due to particle precipitation rather than Joule heating. The most interesting feature of the response is the pronounced peak on the magnetic equator, apparently related to the growth and decay of the storm-time ring current. An important loss process discussed for ring current protons is the charge-exchange collision with neutral H-atoms. (UK)

25083 STUDIES OF D-REGION DRIFTS DURING THE WINTERS OF 1970–1972. Stubbs, T. J.; Vincent, R. A. (Univ. of Adelaide). Aust. J. Phys.; 26: No. 5, 645-660(Oct 1973).

Partially reflected radio waves have been used to study D-region drifts in the midwinter month of July for the years 1970-72. The drifts are shown to agree well with wind estimates at similar heights obtained using meteor radar techniques. The behavior of the drifts is consistent with a strong tidal influence, and the nature of these tides is discussed with emphasis on the phase and amplitude variations in time and height. Comparison of the monthly mean drift profiles with wind models leads to a particularly good representation of the expected zonal drift profile. No evidence is found for any anomalous winter behavior. (auth)

25084 INTERPRETATION OF 6300 Å AIRGLOW OBSERVATIONS OF IONOSPHERIC IRREGULARITIES. Dyson, P. L.; Hopgood, P. A. (La Trobe Univ., Bundoora, Australia). Planet. Space Sci.; 22: No. 3, 495-497(Mar 1974).

The variations in intensity of 6300 Å airglow throughout the ionosphere above an observer are represented by a three dimensional Fourier series. Filtering effects caused by the field of view of an observing instrument are then calculated assuming that all Fourier components move with the same velocity. The results suggest that the observations of Mullaney et al (Planet. Space Sci.; 20: 41 and 1982(1972)) can be interpreted as the power spectrum of horizontal structures in the airglow. (auth)

25085 EXCITATION PROCESSES AND PULSATIONS IN THE POLAR AURORA. Harang, O. E. (Auroral Observatory, Tromsoe, Norway); Gerard, J. C. Bull. Soc. Roy. Sci. Liege; 42: No. 9-10, 465-486(1973).

This report reviews recent progress in theories and observations of excitation processes of electron aurora. In the last I.A.G.A. meeting of 1971 a similar report was given by Shepard (1972). After summarizing some characteristic features of auroral electrons, the atmosphere's response to electron precipitation is described. The atmosphere reacts with the primary energy spectrum, deforms it and secondary electrons are produced locally. This combined primary and secondary electron beam excites and ionizes the atmosphere giving rise to an emission and ionization profile which mainly depends on the incident primary flux. Recent work in the primary/secondary electron spectra is described and important gaps in the understanding of this problem are pointed out. The ions and the metastables react with the atmosphere through secondary processes by a complex set of chemical and recombination processes, and some of the recent results are discussed. As secondary processes involve different reaction rates, the different processes have characteristic time constants. Some knowledge of these reaction coefficients can be learned by observing atmospheric response to fluctuating aurora. (auth)

25086 F-LAYER IRREGULARITIES AS DETERMINED BY BACKSCATTER STUDIES AT 19 MHz OVER HALF OF A SOLAR CYCLE. Basu, S. (Emmanuel Coll., Boston); Vesprini, R. L.; Aarons, J. Radio Sci.; 9: No. 3, 355-371(Mar 1974).

A continuous series of backscatter observations at 19 MHz made at Plum Island, Massachusetts, 56°N invariant latitude, over nearly half a solar cycle is utilized to derive occurrence characteristics of ground backscatter propagated by means of F-layer reflection, 1F, as well as those of aspect-sensitive field-aligned echoes from the F layer, FAE(F). Neither field-aligned E-layer echoes nor ground backscatter propagated by means of sporadic E were found to produce any noticeable blanketing of the radar signal for this frequency and radar location. The 1F propagation showed marked sunspot cycle and azimuthal dependence and was strongest in winter and weakest in summer. Under quiet magnetic conditions FAE(F) was primarily a sunset phenomenon, occurring usually at delays of 7 to 10 msec, with a marked sunspot cycle dependence. Some daytime activity was observed at longer delays of 20 to 22 msec which could be explained in terms of F-layer field alignment after one intermediate ground reflection. The occurrence of FAE(F) during magnetic storms showed a seasonal variation in agreement with the well-known storm behavior of f_0F_2 at these latitudes. In general, however, the occurrence of FAE(F) increased monotonically with increasing magnetic activity until the threshold of $K_{Fr} = 4$ was reached, beyond which the depletion in the F-layer background ionization caused it to decrease, with complete cut-off occurring irrespective of season during very disturbed conditions, $K_{Fr} \geq 7$. With the aid of ray traces, the occurrence statistics of both 1F and FAE(F) are interpreted and discussed in terms of the geometry of the probing radar, the various factors controlling F-layer propagation, and the extent of the F-layer irregularity region. (auth)

25087 ACCURACY OF ROCKET MEASUREMENTS OF LOWER IONOSPHERE ELECTRON CONCENTRATIONS. Mechtly, E. A. (Univ. of Illinois, Urbana). Radio Sci.; 9: No. 3, 373-378(Mar 1974).

Measurements of electron concentration taken at the same time and at the same place in the lower ionosphere by independent instrumentation mounted on the same rocket are described. The technique utilizes Faraday rotation and differential absorption of radio waves propagating from the ground to the rocket at two different frequencies. Agreement near 90 km within ±7%, ±6%, ±8%, and ±3% is demonstrated by the four available cases of coincidence in time and altitude. Maximum dispersion at other altitudes is calculated from known random errors. Stronger variation of electron collision frequency with altitude than with season is indicated by 34 measurements between 75 and 100 km. Insensitivity of electron concentration determinations at 72 km to errors in extrapolated collision frequency models is demonstrated. Partial reflection data are compared with rocket results in the one case of commonality in time and place. (auth)

25088 STATISTICAL SUMMARY OF ARECIBO NIGHTTIME E-REGION OBSERVATIONS. Rowe, J. F. Jr. (Arecibo Observatory, Puerto Rico). J. Geophys. Res.; 78: No. 28, 6811-6817 (1 Oct 1973).

A summary is presented of nighttime sporadic E layer observations and integrated content measurements made at the Arecibo Observatory during the period February 1972 to January 1973. The data were obtained with the use of 13-bit Barker-coded incoherent scatter radar pulses, giving a height resolution of 900 meters. A total of 91 hours of data spanning 17 nights is incorporated in this summary. Descriptions of layer formation and motion seen on individual nights are in preparation and will be published separately. (auth)

25089 RESPONSE OF POLAR CAP CONVECTION TO THE INTERPLANETARY MAGNETIC FIELD. Mozer, F. S.; Gonzalez, W. D. (Univ. of California, Berkeley). J. Geophys. Res.; 78: No. 28, 6784-6786(1 Oct 1973).

Because the relationship between convection and the interplanetary magnetic field is of crucial importance to the understanding of the large-scale interaction between the solar wind and the geomagnetic field, 227 hours of polar-cap balloon electric-field measurements were examined in search of such a relationship, with the conclusion that magnetic field reconnection dominates viscous interaction or any other mechanism for transferring energy to the magnetosphere. (WDM)

25090 SIMULTANEOUS IN SITU ELECTRON TEMPERATURE COMPARISON OF ALOUETTE 2 PROBE AND PLASMA RESONANCE DATA. Benson, R. F. (Goddard Space Flight Center, Greenbelt, MD). J. Geophys. Res.; 78: No. 28, 6755-6759(1 Oct 1973).

The electron temperatures deduced from Alouette 2 diffuse resonance observations are compared with the temperatures obtained from the Alouette 2 cylindrical electrostatic probe experiment using data from five mid- to high-latitude telemetry stations. The probe temperature is consistently higher than the diffuse resonance temperature. The average difference ranged from approximately 10% to 40%, the lower values occurring at the lowest altitudes sampled (near 500 km) and at high latitudes (dip latitude greater than 55°) and the larger values occurring at higher altitudes and lower latitudes. The discrepancy appears to be of geophysical origin, since it is dependent on the location of the data sample. The present observations support the view that the discrepancy often observed between radar backscatter and probe electron temperature is of geophysical origin. (auth)

25091 ENHANCED SCATTERING AND DECAY OF ELECTROMAGNETIC WAVES IN THE IONOSPHERE. Bornatici, M. (European Space Research Inst., Frascati, Italy); Engelmann, F. J. Geophys. Res.; 78: No. 28, 6760-6767(1 Oct 1973).

A theoretical analysis of the possibility of nonlinearly exciting a Langmuir wave by electromagnetic waves generated in the ionosphere at an altitude of 500 km is presented. It is shown that for the effect to occur a transmitter having a power of about 10 kw in the frequency range between 8 and 25 MHz is required in situ. The Langmuir waves generated travel typically in the same direction as the primary beam. The possibility of using electromagnetic waves of 3 GHz is also considered, but in this case the effect is too weak to be detectable at acceptable power levels. (auth)

25092 EFFECT OF ENERGETIC OXYGEN ATOMS ON NEUTRAL DENSITY MODELS. Rohrbaugh, R. P.; Nisbet, J. S. (Pennsylvania State Univ., University Park). J. Geophys. Res.; 78: No. 28, 6768-6772(1 Oct 1973).

The dissociative recombination of O_2^+ and NO^+ in the F region results in the production of atomic oxygen and atomic nitrogen with substantially greater kinetic energy than the ambient atoms. In the exosphere these energetic atoms have long free paths. They can ascend to altitudes of several thousand kilometers and can travel horizontally to distances of the order of the Earth's radius. The distribution of energetic oxygen atoms is derived by means of models of the ion and neutral densities for quiet and disturbed solar conditions. A distribution technique is used to study the motion of the atoms in the collision-dominated region. Ballistic trajectories are calculated in the spherical gravitational field of the Earth. The present calculations show that the number densities of energetic oxygen atoms predominate over the ambient atomic oxygen densities above 1000 km under quiet solar conditions and above 1600 km under disturbed solar conditions. (auth)

25093 ROLE OF THE NEUTRAL SHEET IN THE ILLUMINATION OF POLAR CAPS BY SOLAR PROTONS. Gall, R.; Bravo, S. (Universidad Nacional Autonoma de Mexico, Mexico City). J. Geophys. Res.; 78: No. 28, 6773-6776(1 Oct 1973).

The role that the neutral sheet plays in the access of solar protons into the geomagnetic cavity is considered. Additional theoretical considerations are provided on the formation of the peaks of flux observed over the lower latitudes of the polar caps during the anisotropic phase of solar events. (WDM)

25094 PENETRATION OF THUNDERCLOUD ELECTRIC FIELDS INTO THE IONOSPHERE AND MAGNETOSPHERE. I. Middle and Subauroral Latitudes. Park, C. G.; Dejnakarintra, M. (Stanford Univ., CA). J. Geophys. Res.; 78: No. 28, 6623-6633(1 Oct 1973).

The mapping of thundercloud electric fields at middle and subauroral latitudes is investigated analytically as a three-dimensional boundary value problem. The electrical conductivity is represented by several piecewise exponential functions of altitude, and the anisotropy of the medium is taken into account above 70-km altitude. The geomagnetic field lines are assumed to be straight and vertical below 150-km altitude. Electric field strength at great heights depends sensitively on conductivity and thundercloud models used in the calculations. Sample calculations using representative nighttime profiles show that "giant" thunderclouds can produce transverse electric fields of tens of microvolts per meter in the equatorial plane of the midlatitude magnetosphere. In the daytime, corresponding electric fields are about an order of magnitude less. These results suggest that giant thunderclouds may be an important source of localized electric fields that can form field-aligned electron density irregularities in the ionosphere and the magnetosphere. (auth)

25095 PROBE ELECTRIC FIELD MEASUREMENTS NEAR A MIDLATITUDE IONOSPHERIC BARIUM RELEASE. Schutz, S.; Adams, G. J.; Mozer, F. S. (Univ. of California, Berkeley). J. Geophys. Res.; 78: No. 28, 6634-6642(1 Oct 1973).

A double-probe measurement of midlatitude ionospheric electric fields was made on a rocket flight near a large, artificial, barium plasma cloud. The measurement was made after ground sunset on February 1, 1971, near L = 1.8, 7 min after the release of the barium and 4 min before the visual onset of its striations. The cloud-associated perturbation of the approximately 4-mv/m electric field in an Earth-fixed frame of reference was in agreement with theoretical expectations based on the enhancement of the Pedersen conductivity produced by the cloud and lends support to the gradient drift instability model of striation formation. The motion of the leading edge of the barium cloud was consistent with that expected from the rocket electric field measurement. The ionospheric electric field in a frame of reference not rotating with the Earth differed from the corotation electric field by about 20% during the flight. (auth)

25096 NEUTRAL WINDS ABOVE 200 KM AT HIGH LATITUDES. Meriwether, J. W.; Heppner, J. P.; Stolarik, J. D.; Wescott, E. M. (Goddard Space Flight Center, Greenbelt, MD). J. Geophys. Res.; 78: No. 28, 6643-6661(1 Oct 1973).

Electrically neutral, luminous clouds are a by-product of chemical releases conducted to create barium ion clouds for the measurement of electric fields. Wind measurements provided by the motions of these clouds are particularly valuable in that the motions can be directly compared with convective ion drift motions to test the importance of ion drag forces. Motion from multiple releases between 200 and 300 km from 15 rockets launched from four high-latitude locations is analyzed in this paper. The observations in the evening and midnight hours at magnetic latitudes of ≥65° strongly suggest that in these regions ion drag is the dominant force in driving neutral winds between 200 and 300 km. This conclusion is based on both the agreement between ion and neutral drift directions and the fact that there are distinct changes in the wind associated with (a) the reversal in east–west ion drift at the Harang discontinuity, and (b) the transition from auroral belt sunward ion drift and polar cap antisolar ion drift. In the morning sector it is evident that neutral wind observations cannot be directly interpreted in terms of ion drag; other factors must be considered, such as inertial effects from ion drag, a lack of sufficient ionization for strong coupling of ion neutral motions, and wind forces other than ion drag forces. (auth)

25097 DISTRIBUTION OF ATOMIC OXYGEN IN THE UPPER ATMOSPHERE DEDUCED FROM OGO 6 AIRGLOW OBSERVATIONS. Donahue, T. M.; Guenther, B.; Thomas, R. J. (Univ. of Pittsburgh). J. Geophys. Res.; 78: No. 28, 6662-6689(1 Oct 1973).

The atomic oxygen distribution as a function of altitude between 80 and 120 km and as a function of latitude was deduced from OGO 6 557.7-nm airglow photometer data obtained between August 1969 and April 1970. The results indicate that the density ranges between 1.5 and 5×10^{10} cm^{-3} at 120 km; that there is a semiannual variation by a factor of 3 in the global average density near 100 km in phase with the satellite drag semiannual effect; and that large latitudinal variations occur with maximums between 40° and 60° in the winter hemisphere and sometimes deep minimums in the tropics. The implication of these results for meridional and vertical transport patterns is discussed. (auth)

25098 ATOMIC OXYGEN DENSITIES IN THE LOWER THERMOSPHERE AS DERIVED FROM IN SITU 5577-A Night Airglow and Mass Spectrometer Measurements. Offermann, D. (Univ., Bonn); Drescher, A. J. Geophys. Res.; 78: No. 28, 6690-6700 (1 Oct 1973).

Atomic oxygen number densities measured by a mass spectrometer with a cryoion source and a 5577-A night airglow photometer flown in the same rocket payload are discussed. The airglow data are further compared with the number densities obtained from a number of previous photometer experiments and from another cryomass spectrometer. The volume emission rates of the previous airglow measurements were taken from the literature and converted to O number densities by a new set of rate coefficients. The comparison with the mass spectrometer data indicates that these coefficients yield usable oxygen number densities. The oxygen densities are correlated with several geophysical parameters. A seasonal variation of the peak density of the oxygen layer is found showing a flat summer maximum. The altitude at which the peak of the layer occurs shows a seasonal variation with a minimum in summer. Combination of these two counteracting effects yields two results: (1) it indicates a quasi-semiannual variation of the 5577-A light emission of the oxygen layer and (2) by an extrapolation it yields a seasonal variation of the atomic oxygen number density at higher altitudes with a pronounced summer minimum. (auth)

25099 THERMALIZATION AND TRANSPORT OF PHOTOELECTRONS: A COMPARISON OF THEORETICAL APPROACHES. Cicerone, R. J. (Univ. of Michigan, Ann Arbor); Swartz, W. E.; Stolarski, R. S.; Nagy, A. F.; Nisbet, J. S. J. Geophys. Res.; 78: No. 28, 6709-6728(1 Oct 1973).

Three commonly cited methods to study ionospheric photoelectron thermalization and transport are compared. Transport effects are evaluated quite differently in the three approaches: one uses a diffusion equation formulation, the second proceeds from a two-stream approximation to the general particle transfer equation, and the third employs a Monte Carlo technique to simulate electron trajectories. The comparison is achieved by applying each method to identically prepared models, one representing an overhead Sun, another for a sunrise situation. Photoelectron fluxes are computed as a function of altitude, energy, and pitch angle. Heating rates for the ambient thermal electrons and neutral excitation rates are also presented. The results show close agreement between the three methods for altitudes in the region of local energy loss, but higher altitudes reveal a discrepancy of as much as a factor of 2 in the net flux of photoelectrons. This discrepancy is discussed and then removed by appropriately modifying the computational techniques. The escape fluxes predicted ($\sim 3 \times 10^8$ cm^{-2} sec^{-1}) from the input data are generally lower than most measured values. (auth)

25100 ELECTRIC FIELD OBSERVATIONS BY INCOHERENT SCATTER RADAR IN THE AURORAL ZONE. Banks, P. M. (Univ. of Alaska, Fairbanks); Doupnik, J. R.; Akasofu, S. I. J. Geophys. Res.; 78: No. 28, 6607-6622(1 Oct 1973).

Analysis of ion drift velocity measurements, made for a 24-hour period in February 1972 by the incoherent scatter radar at Chatanika, Alaska (L = 5.7), provides a detailed view of electric fields and currents in the auroral zone. Large northward electric fields were seen in the evening sector, and an abrupt change to southward occurred at the start of a midnight sector substorm. The westward electric field was generally much smaller than the north–south electric field but showed a rapid increase at the time of a westward auroral surge. Study of global magnetograms and all-sky camera photographs has led to the identification of five substorms during the 24-hour observation period. These substorms were sufficiently separated in time to allow identification of the electric field and current variations in late afternoon, evening, and morning local time sectors. (auth)

25101 ENERGY DEPOSITION OF PROTONS IN MOLECULAR NITROGEN AND APPLICATIONS TO PROTON AURORAL PHENOMENA. Edgar, B. C.; Miles, W. T.; Green, A. E. S. (Univ. of Florida, Gainesville). J. Geophys. Res.; 78: No. 28, 6595-6606(1 Oct 1973).

Motivated by proton auroral studies, the microscopic approach developed for electrons, which is based on detailed collisional cross sections, was extended to deal with the problem of proton energy deposition in N_2. The calculated excitation efficiencies, which include the contributions from charge exchange processes and secondary electrons, remain fairly constant from 1 keV to 10 MeV for the ionization states but vary considerably below 10 keV for excitation states and dissociation processes due to charge exchange effects. The estimates of the Lyman α and Hα photon production were found to be very sensitive to the low-energy hydrogen impact cross section. The Lyman α and Hα photon production tended to be higher than previous estimates of Eather. Good agreement with the results of Chubb and Hicks was obtained for the Lyman α/Lyman–Birge–Hopfield intensity ratio. Total intensities for a typical proton auroral energy of 4 keV and a polar glow aurora of 1 MeV are presented. (auth)

25102 RADIO SCINTILLATION ON STELLAR SIGNALS DURING ARTIFICIAL IONOSPHERIC MODIFICATION. Rufenach, C. L. (Space Environment Lab., Boulder, CO). J. Geophys. Res.; 78: No. 25, 5611-5621(1 Sep 1973).

Scintillation signals from the radio sources Cyg A and Cass A were taken at 26 MHz on nine evenings in 1971 and 1972 at times of ionospheric modification by a high-powered hf transmitter near Boulder, Colorado. The scintillation character often changes significantly during modification. The artificially produced scintillations are either rapid and random or deep long-period modulation. The random scintillations and ionogram signatures (spread F and wide-band attenuation) are directly correlated with transmitter operation and are interpreted in terms of small irregularities (dimensions of 1 to 4 km), whereas the long-period modulation can be interpreted in terms of large irregularities (dimensions of about 10 to 100 km). Small irregularities are similar to natural ones and require a short time to develop, less than a few seconds, but the large irregularities differ from the natural ones and usually take from 5 to 15 min after transmitter "on" to develop. (auth)

25103 RADIO FREQUENCY HEATING EFFECTS ON ELECTRON DENSITY IN THE LOWER E REGION. Willis, J. W.; Davis, J. R. (Naval Research Lab., Washington, DC). J. Geophys. Res.; 78: No. 25, 5710-5717(1 Sep 1973).

Attention is drawn to the fact that the high-powered radio wave heaters developed for modifying F region ionospheric parameters can have a detectable influence on E region electron densities as well. Anticipated density variations are calculated for typical daytime and nighttime conditions. Furthermore, it is suggested that such variations will perturb the ionospheric dynamo current, thereby leading to a perceptible variation in the associated magnetic field measured on the ground. (auth)

25104 NUMERICAL DESCRIPTION OF THE WINTER ANOMALY IN IONOSPHERIC ABSORPTION FOR A SUNSPOT CYCLE. Roettger, J.; Schwentek, H. (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.). J. Atmos. Terrest. Phys.; 36: No. 2, 363-366 (Feb 1974).

The nearly complete set of data L(cos χ = 0.1) obtained from a continuous recording of the diurnal variation of absorption L from 1961 to 1972 using the A3 circuit Norddeich–Lindau (2.61 MHz; 296 km) was analysed to find a numerical description of the behavior of the winter anomaly in the course of a sunspot cycle. It is shown that the characteristic data describing the winter anomaly are significantly correlated to mean sunspot number; they can be used also for practical purposes. (auth)

Magnetospheric Phenomena

25105 (AD-763433) HIGH-ENERGY PROTON RADIATION BELT. White, R. S. (California Univ., Riverside (USA)). 22 Jan 1973. Contract N00014-69-A-0200-5001. 86p. (IGPP-UCR-73-4). NTIS $3.00.

The experiments and theories to explain the high-energy protons trapped in the Earth's radiation belt are reviewed. The theory of cosmic-ray albedo neutron decay injection of protons into the radiation belt is discussed. Radial diffusion and change in the Earth's dipole moment are included along with losses of protons by ionization and nuclear collision. It is found that the measured albedo neutron escape current is sufficient to supply trapped protons above 30 MeV. The theoretical calculations of the trapped protons are in agreement with the measurements for L > or = 1.7 both on and off the equator. While it appears that diffusion of solar-wind protons is responsible for most of the portons less than 30 MeV, additional measurements of the angular distributions and fluxes of low-energy neutrons are required to determine the contribution of the cosmic-ray albedo neutron decay source. For L < or = 1.7 additional trapped proton differential energy measurements should be made before the theory can be adequately tested. It appears that an additional loss mechanism such as pitch angle scattering may be required. (auth)

25106 (AD-764297) PROFILE-INVERSION TECHNIQUE FOR THE DETERMINATION OF ELECTRON DENSITY FROM WAVE INTERACTION DATA. Dale, S. P. (Pennsylvania State Univ., University Park (USA). Ionosphere Research Lab.). 2 Jul 1973. Contract N00014-67-A-0385-0014. 74p. (PSU-IRL-SCI-417). NTIS $3.50.

The wave interaction experiment is described and the development of the complex coefficient of interaction is reviewed. A numerical technique to solve the wave interaction equations for electron density is then presented. Briefly, the wave interaction equations, for both delta and finite pulse widths, are written in matrix form and then an overdetermination scheme is applied to reduce the undesirable effects of noisy data. The technique is critically tested, using both theoretical and experimental data, and is shown to be practical for routine use. (auth)

25107 (AD-765744-8) HEAVY ION INVESTIGATIONS. Final Report for Period Ending 30 Jul 1973. Sharp, R. D.; Johnson, R. G. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Lockheed Palo Alto Research Lab.). 30 Jul 1973. Contract N00014-73-C-0165. 39p. (LMSC-D-352865). NTIS $3.00.

Heavy ions with energies between 1 and 9 keV have frequently been detected with an energetic ion mass spectrometer on the satellite 1969-25B during the period March 1969 to August 1970. Their identification as 0+ ions of ionospheric origin has been inferred from a comparison with the more complete mass measurements with an improved spectrometer on the satellite 1971-089A, and from considerations of ionospheric and solar wind abundance ratios. Data from nine magnetic storms have been analyzed, and the peak responses occurred at L values between 3.4 and 6.4, and at magnetic local times between 21.8 and 4.5 hours. A maximum flux of approximately 0.1 erg/sq. cm-sec-sterad was observed during the March 23-24, 1969 storm. (GRA)

25108 (AD-766463-4) STUDY OF EQUATORIAL INNER BELT PROTONS FROM 2 TO 200 MeV. Claflin, E. S.; White, R. S. (California Univ., Riverside (USA)). 6 Aug 1973. Contract N00014-69-A-0200-5001. 34p. (IGPP-UCR-73-39). NTIS $3.00.

The diffusion theory of inner belt protons is extended to lower energies for comparison with the data of Hovestadt et al. The effects of Coulomb energy loss, nuclear inelastic scattering, and the secular decrease of the Earth's magnetic field are included. The Farley and Walt solar cycle averaged atmosphere and a neutron source based on the most recent measurements are used. It is found that diffusion theory can account for the observed flux of low-energy protons provided that the diffusion coefficient increases at smaller values of the first invariant. This result is interpreted as additional evidence for the importance of electrostatic field fluctuations in causing radial diffusion. It is also found that the excess of protons predicted by the theory at and above 400 MeV/gauss cannot be attributed to pitch angle scattering. Increasing the free electron density by a factor of 5 improves agreement between theory and experiment. (auth)

25109 (UCRL-51470) ELECTRONS AT LOW ALTITUDES: A DIFFICULT BACKGROUND PROBLEM FOR SOFT X-RAY ASTRONOMY. Seward, F. D.; Grader, R. J.; Toor, A.; Burginyon, G. A.; Hill, R. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Oct 1973. Contract W-7405-eng-48. 31p. Dep. NTIS $4.00.

Quasi-trapped and precipitating electrons have been observed with rocket-borne x-ray astronomy detectors in the altitude range 150 to 500 km. Because the flights occurred at low magnetic latitudes the electrons were unexpected. Data from many flights are combined to derive altitude dependence, an average electron spectrum, and variation with solar activity. Development of electron-rejecting collimators is discussed, and laboratory and flight data on these collimators are presented. (auth)

25110 EARTH'S MAGNETIC FIELD AND ITS CONSEQUENCES IN SPACE RESEARCH. Combou, F. (Univ., Toulouse). Bull. Union Physiciens; 68: No. 559, 129-153(Nov 1973). (In French).

The solar wind and the magnetosphere are situated in the framework of galactic space. The magnetic fields measured in the Earth's space and galactic space are small. Beginning with the dipole model representing the Earth's magnetic field, the field lines of force and the conjugate points and observation stations are defined. The different types of variation in the Earth's magnetic field (regular and secular, magnetic storms, and micropulses) and their origins are discussed. (FR)

25111 CHARACTERISTICS OF THE SOLAR DIURNAL VARIATION ACCORDING TO DATA OF THE KAZAKHSTAN MAGNETIC OBSERVATORIES. Rudina, M. P.; Pogrebnoi, V. N.; Zhumabaev, B. T. Vestn, Akad. Nauk Kaz. SSR; No. 6, 66-68(Jun 1973). (In Russian).

The study of the seasonal behavior of the variability of the absolute levels of the H, Z, and D components at different hours of the day showed a complete series of anomalies in the character of the solar diurnal variations during the course of the year. For example the level of the H-component field in the daylight hours of winter is higher than in summer but in the night hours it is higher in summer than in winter. The level of the H-component field at 8 to 9 in the morning and 13 to 14 in the evening is practically uncharged during the year. The Z and D components in the night hours are practically unchanged. In the daylight hours in the spring the level of the Z-component field decreases but the D component increases in the morning hours and decreases in the evening hours. The forms of the ΔH, ΔZ, and ΔD curves coincide with the forms of the diurnal variation curves of the corresponding elements of the H, Z, and D components of the geomagnetic field. (JSR)

25112 OBSERVATION OF PLASMA FLOW IN THE NEUTRAL SHEET AT LUNAR DISTANCE DURING TWO MAGNETIC BAYS. Burke, W. J.; Reasoner, D. L. (Rice Univ., Houston, TX). J. Geophys. Res.; 78: No. 28, 6790-6792(1 Oct 1973).

A report is presented on the simultaneous observations of plasma flowing away from the Earth and a southward-directed magnetic field across the neutral sheet at lunar distance during two weak magnetic bays. These simultaneous observations are in accord with the predictions of magnetic merging models for the generation of magnetic substorms. (WDM)

25113 COMMENTS ON PITCH ANGLE DIFFUSION IN THE RADIATION BELTS. Lyons, L. R. (National Oceanic and Atmospheric Administration, Boulder, CO). J. Geophys. Res.; 78: No. 28, 6793-6797(1 Oct 1973).

Modifications of properties that result from consideration of the dipole geometry of the geomagnetic field are discussed. Also, particle pitch angle distributions and lifetimes are calculated for various rates of pitch angle diffusion, and effects resulting from variations of the diffusion rates with pitch angle are evaluated. A formalism is presented for determining the effect of particle sources on the lifetimes of radiation belt particles. (WDM)

25114 FLUID DYNAMICS AND BOW SHOCK MOTION. Formisano, V. (Univ., Rome). J. Geophys. Res.; 78: No. 28, 6787-6789 (1 Oct 1973).

The position of the bow shock far back in the magnetotail (68 R_E) was studied for extremely low Mach numbers. (WDM)

25115 NONLINEAR SATURATION OF THE GRADIENT DRIFT INSTABILITY IN THE EQUATORIAL ELECTROJET. Rognlien, T. D.; Weinstock, J. (National Oceanic and Atmospheric Administration, Boulder, CO). J. Geophys. Res.; 78: No. 28, 6808-6810(1 Oct 1973).

The fluctuation amplitudes of long-wavelength density irregularities in the equatorial electrojet are predicted by using the results of the nonlinear theory of perturbed electron orbits. Good agreement is found with the density fluctuations of 2 to 22% observed by a rocket experiment. (auth)

25116 PLASMA OSCILLATIONS AT 2 TO 3 MILLIHERTZ AT 6.6 EARTH RADII. Baxter, D.; LaQuey, R. (Univ. of California, San Diego, La Jolla). J. Geophys. Res.; 78: No. 28, 6798-6801(1 Oct 1973).

This letter reports the observation of plasma oscillations at millihertz frequencies by the plasma experiment on ATS 5. Data are reported from the electron analyzers, which provide measurements of the electron flux at 62 exponentially spaced energies between 50 eV and 50 keV. A complete spectrum was obtained once each 20.48 sec. (WDM)

25117 TRIAXIAL MAGNETIC MEASUREMENTS OF FIELD-ALIGNED CURRENTS AT 800 KILOMETERS IN THE AURORAL REGION: INITIAL RESULTS. Armstrong, J. C.; Zmuda, A. J. (Johns Hopkins Univ., Silver Spring, MD). J. Geophys. Res.; 78: No. 28, 6802-6807(1 Oct 1973).

A three-axis magnetometer experiment for measuring the magnetic effects of field-aligned currents at auroral latitudes is described. Some of the results obtained to date are presented, and some preliminary conclusions are discussed. (WDM)

25118 HF ABSORPTION NEAR THE POLAR CAP EDGE DURING PCA EVENTS. Zmuda, A. J.; Potemra, T. A. (Johns Hopkins Univ., Silver Spring, MD). J. Geophys. Res.; 78: No. 25, 5818-5821(1 Sep 1973).

Sometimes during PCA events the hf (3 to 30 MHz) absorption observed at a riometer station near the polar cap edge decreases, although it remains constant or even increases at a higher-latitude station. The absorption stays depressed for a few hours and then returns to or near the predecrease level. The effect often occurs in the local forenoon hours, is called the midday recovery, and has been attributed to an increase in geomagnetic cutoff energy of solar protons or to development of an anisotropic pitch angle distribution of solar protons. Two recoveries are discussed in relation to satellite proton observations along meridians near those of the ground station. (WDM)

25119 EXPANSION OF AN ION CLOUD IN THE EARTH'S MAGNETOSPHERE. Hohl, F. (Langley Research Center, Hampton, VA). J. Geophys. Res.; 78: No. 25, 5785-5794(1 Sep 1973).

The initial expansion of a barium ion cloud release in the distant magnetosphere is numerically investigated by means of a computer model with self-consistent electric and magnetic interactions. Initial conditions for the calculations are an expanding neutral cloud that is photoionized with a time constant of 20 sec. The results show that after the first 30 sec, the large fluctuations in the magnetic field and in other parameters are damped out and the magnetic field in the central region of the cloud is reduced to near zero. Also, after only 10 sec, a relatively high central ion density has developed and remains for the duration of the calculations. (auth)

25120 PERIODICALLY STRUCTURED Pc 1 MICROPULSATIONS DURING THE RECOVERY PHASE OF INTENSE MAGNETIC STORMS. Heacock, R. R.; Akasofu, S. I. (Univ. of Alaska, Fairbanks). J. Geophys. Res.; 78: No. 25, 5524-5536 (1 Sep 1973).

The occurrence of periodically structured Pc 1 (pPc 1) during several intense geomagnetic storms is examined in detail. Unlike unstructured or quasi-structured Pc 1, pPc 1 strongly tend to occur only during a later epoch of the recovery phase of geomagnetic storms. The available pPc 1 data, together with satellite and ionospheric data, are consistent with the idea that pPc 1 activity originates in the proton electromagnetic cyclotron instability that occurs when the high-energy tail of the ring current is brought to the stable trapping limit. This occurs in the late recovery phase when the plasmasphere has filled sufficiently from the ionosphere. Some characteristics of the observed pPc 1 activity are found to be dependent on the character of minor substorm activity occurring on the ring current recovery phase. (auth)

25121 ELECTRON CONCENTRATIONS CALCULATED FROM THE LOWER HYBRID RESONANCE NOISE BAND OBSERVED BY OGO 3. Burtis, W. J. (Stanford Univ., CA). J. Geophys. Res.; 78: No. 25, 5515-5523(1 Sep 1973).

A noise band at the lower hybrid resonance is often detected by the Stanford University-Stanford Research Institute vlf and elf receivers on OGO 3, using the electric antenna. In some cases the noise band is at the geometric mean gyrofrequency $(f_{He}f_{Hi})^{1/2}$ as measured by the Goddard Space Flight Center (GSFC) magnetometer, and local LHR in a dense ($f_{pe} \gg f_{He}$) H^+ plasma is indicated. In other cases the noise band drops to lower frequencies, and a more dilute ($f_{pe} \lesssim f_{He}$) plasma is indicated; in such cases, electron concentration can be calculated, if it is assumed that heavy ions are negligible. Observations at mid-latitudes and altitudes of a few Earth radii show local concentrations as low as 1.4 el/cm^3. In one case the concentrations obtained from the LHR noise band agree with those measured simultaneously by the GSFC ion mass spectrometer within a factor of 2. In another case the concentration is observed to fall by a factor of 2 in 150 km and then to decrease roughly as R^{-4} in agreement with whistler measurements outside the plasmapause. (auth)

25122 UNEVEN ILLUMINATION OF THE POLAR CAPS BY SOLAR PROTONS: COMPARISON OF DIFFERENT PARTICLE ENTRY MODELS. Morfill, G.; Scholer, M. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). J. Geophys. Res.; 78: No. 25, 5449-5462(1 Sep 1973).

Recent solar proton measurements over the polar caps have shown up some startling features during times of interplanetary particle anisotropies. Explanations of the observations have been based on diffusive entry into the magnetotail, direct entry by motion along trajectories without scattering, and models incorporating both entry mechanisms. The direct entry mode is based on the computation of particle orbits, of points of access, and asymptotic directions at the magnetopause and in the tail. Although different research groups have used trajectory calculations in order to explain observed polar-cap structure, there is considerable disagreement on the computed trajectories and especially on the proposed access mechanisms of solar particles to these trajectories at the magnetopause. In this paper the different models are evaluated, and it is found that the nonadiabatic reconnection model is in good accord with the observations, whereas other models show serious inconsistencies. (auth)

25123 SOLAR CYCLE CONTROL IN THE 27-DAY VARIATION OF GEOMAGNETIC ACTIVITY. Fraser-Smith, A. C. (Stanford Univ., CA). J. Geophys. Res.; 78: No. 25, 5825-5829 (1 Sep 1973).

A recent paper on the spectrum of the geomagnetic activity index Ap reported a clearly resolved spectral doublet in the solar rotation period range. It is shown that strong solar cycle control of a long-lived 27-day variation in geomagnetic activity can account for the observed doublet. (WDM)

25124 OBSERVATION OF THE NONLINEAR INTERACTION OF TORSIONAL HYDROMAGNETIC WAVES. Brennan, M. H.; Cheetham, A. D.; Jones, I. R. (Flinders Univ. of South Australia, Bedford Park). Phys. Lett.; 46A: No. 7, 437-438(11 Feb 1974).

Experimental observations are reported of the nonlinear interaction of two torsional hydromagnetic waves propagating in opposite directions in a cylindrical plasma waveguide. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

25125 PARTICLE PHYSICS. Van der Spuy, E. Tegnikon; 21: No. 2, 28-29(Jun 1972). (In Afrikaans).

From symposium on the future of nuclear physics in South Africa; Pretoria, South Africa (5 Nov 1971).

Particle physics is analyzed and discussed including atomic physics, astrophysics and plasma physics, with a view to future research programs. (auth)

Beams and Their Reactions

Refer also to abstracts 24711, 25717, and 25863.

25126 (CONF-740104-13) SPUTTERING FROM ENERGETIC SELF-ION CASCADES. Merkle, K. L.; Pronko, P. P. (Argonne National Lab., Ill. (USA)). Jan 1973. 20p. Dep. NTIS $3.00.

From surface effects in controlled thermonuclear fusion devices and reactors meeting; Argonne, Illinois, USA (10 Jan 1974).

The rather high primary recoil energies that occur under 14-MeV neutron irradiation can be simulated by self-ion bombardment. However, the primary ion always starts at the entrance surface when self-ion bombardment is used. To examine the effects of cascades in which the momentum of the primary atom is directed towards an exit surface, one has to introduce a second surface that will intersect the cascade in the forward direction. Self-ion transmission sputtering on very thin films was used for this purpose. The analysis was done in situ by He^+ backscattering. A backsputtering ratio of 120 was observed at 540 keV. At the same energy a forward sputtering ratio of 70 is obtained for a film of 660 Å in thickness. These ratios are in order of magnitude agreement with theoretical estimates, however, the results seem to indicate that collective and lattice effects play a significant role. It was observed that a tensile stress is built up in the films during irradiation, leading to flattening and rupturing along preexisting defects. (auth)

25127 DEPENDENCE OF LEED INTENSITY FROM (100) PbS AND LiF ON HELIUM ION BOMBARDMENT DOSES IN ENERGY RANGE 10 TO 10^3 eV. Zyryanov, G. K.; Matsevich, V. G. Vestn. Leningrad. Univ., Fiz., Khim.; No. 10, 61-66 (May 1973). (In Russian).

Intensity degradation of LEED (02, 12), (22, 12), (11, 13) beams from LiF (100) and (117, (226), (026), (315), (117) from PbS (100) was studied in relation to the bombardment doses of helium ion energy 10, 50, 100, 200, 300, 400 eV and 10 to 10^3 eV respectively. The dose dependence was found to be exponential. Inelastic collision probability for helium ion interaction with LiF (100) and PbS (100) surfaces versus ion energy was non-monotonic function. (auth)

25128 ION FOCUSING OF HIGH-VOLTAGE ELECTRON BEAMS. Rybas, K.P.; Babin, G.A.; Lukinykh, V.D.; Telepaev, B.N. (D. V. Efremov Science Research Institute for Electrophysical Equipment, Leningrad). Sov. Phys.-Tech. Phys. 18: No. 3, 322-325 (Sept 1973).

An investigation has been made of ion focusing of a pulsed electron beam formed by a diode electron gun with voltage of 50 kV, pulse length of 4 μsec, repetition freuqency of 50 sec^{-1}, and beam current 560 mA. The electron emitter is a shaped, porous nickel-oxide cathode (HV cathode) which can be operated at a residual gas pressure up to 1.10^{-3} torr. The investigations are performed in a drift space without external electric and magnetic fields. The residual gas pressure is varied in the range 3.10^{-4} to 9.10^{-4} torr by changing the pumping speed with a valve. The current density at the center and edge of the beam is measured using a collector with a small aperture. te experiments show that the time The experiments show that the time required to reach maximum current density at the beam center depends on the beam divergence angle as well as on the residual gas pressure; the larger the angle, the greater is the time required. The maximum ion focusing effect is reached for lower residual gas pressure further from the gun. In contrast with well-known experimental work, no oscillations are observed in the beam when it is fully neutralized. The current density at the beam center in the fully neutralized case is higher than that in the unneutralized case by a factor from 10 to 40. The current density at the beam center is a measure of the residual gas pressure. To expand the range of measured pressure, electron beams with controlled pulse length must be used. (auth)

25129 CRUCIBLE FOR VAPORIZING CHEMICALLY ACTIVE ELEMENTS AND METHOD OF MANUFACTURING THE SAME AND ION SOURCE INCLUDING SAID CRUCIBLE. Kervizic, J.; Masic, R.; Shroff, A.; Warnecke, R. J. (to Thomson-CSF). US Patent 3,789,253. 29 Jan 1974. Priority date 6 Jul 1971, France. 4p.

The invention relates to ion sources having two ionization chambers and more particularly to chemical and heat resistant crucibles for use with said sources. The crucible is a hollow box of pyrolytic tungsten having two opposite openings in its lateral wall. The crucible is manufactured from a pyrolytic tungsten deposite made on a copper mandrel which is dissolved in an etching bath. (Official Gazette)

25130 NONLINEAR EFFECTS IN HEAVY-ION SPUTTERING. Andersen, H.H.; Bay, H.L. (Institute of Physics, University of Aarhus, DK-8000 Aarhus C, Denmark). J. Appl. Phys. 45: No. 2, 953-954 (Feb 1974).

To test the suggestion that an enhancement of sputtering occurs in very dense collision cascades, the sputtering yield per atom was compared for atomic and molecular ions. In all cases tested, the yield per atom was higher for the molecular ions. This effect is the more pronounced the heavier the projectile and the target. In the molecular cases the overlapping cascades have higher energy densities than those initiated by the atomic ions; our results, therefore, support the suggestion of a sputtering enhancement in dense cascades. (auth)

25131 ENERGY LOSS MEASUREMENTS OF LOW ENERGY IONS IN THIN CARBON FOILS. Carriveau, G. W.; Beauchemin, G.; Knystautas, E. J.; Pinnington, E. H.; Drouin, R. (Univ., Laval, Quebec). Phys. Lett., 46A: No. 4, 291-292(31 Dec 1973).

The energy losses in thin carbon foils of ions of N, Ne, Ar, Mn, Kr, and Xe were measured at 100 keV and 200 keV using a high-resolution magnetic spectrometer, with a view to improving the accuracy of beam-foil lifetime measurements. For high-Z particles, the results show that a straightforward application of the Linhard-Scharff-Schiott total stopping cross-sections to beam-velocity correction can substantially overestimate the reduction in velocity due to the foil. (auth)

25132 GAS UTILISATION IN ION SOURCES. Green, T. S. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Nucl. Instrum. Methods; 115: No. 2, 615-617(1974).

A general expression is developed for the dependence of the gas utilization factor in an ion source on the probability of ionization of atoms in the source. (auth)

25133 VELOCITIES AND ENERGIES OF IONS MOVING IN STRONG ELECTRIC AND ARBITRARY MAGNETIC CROSSED FIELDS. Sherman, J. C. (Kungliga Tekniska Hoegskolan, Stockholm). J. Phys., B (London); 7: No. 2, 244-255(1 Feb 1974).

The average velocities and energies of ions moving through a gas in almost perpendicular electric and magnetic fields are calculated. The electric field is taken to be strong enough to give ion energies of a few eV or more, but the magnetic field strength is arbitrary. Symmetric charge exchange is taken to be the most important type of ion collision, and the average initial energy and mean distance moved by the fast neutrals so formed are also briefly discussed. Ion-ion Coulomb collisions and elastic ion-neutral collisions are included as subsidiary types of collision. Symmetric charge exchange produces a large anisotropy in the ion energy which is reduced by the Coulomb and elastic scattering. Expressions are found for the resulting average ion energy parallel to the magnetic field. Examples show that with ion energies of more than a few eV the parallel energy caused by neutral scattering is less than a few percent of the total average energy. The effect of Coulomb collisions depends strongly on the ion energy, but again the anisotropy can be large for degrees of ionization up to 10%. The anisotropy has important consequences for ion diffusion and plasma stability. (auth)

Atomic and Molecular Properties

Refer also to abstracts 25164, 25165, 25167, 25173, and 25208.

25134 (ANL-8060(Pt. 1), pp 24-31) SOME PROPERTIES OF THE GENERALIZED OSCILLATOR STRENGTH AND THEIR RELATION TO INELASTIC SCATTERING OF CHARGED PARTICLES. III. The Hydrogen Atom With Principal Quantum Number 2. Matsuzawa, M.; Inokuti, M. 1973.

In Radiological and Environmental Research Division annual report: radiation physics, July 1972—June 1973.

Comprehensive data on the generalized oscillator strength of the hydrogen atom in the 2s and 2p states are presented in the form of the Bethe surface. In addition to usually expected features, such as the dipole dominance at lower excitations and the Bethe ridge, a minimum in the generalized oscillator strength for the 2s → continuum transition at certain momentum transfers is noted. (6 figures) (auth)

25135 (ANL-8060(Pt. 1), pp 32–48) SOME PROPERTIES OF THE GENERALIZED OSCILLATOR STRENGTH AND THEIR RELATION TO INELASTIC SCATTERING OF CHARGED PARTICLES. IV. The Hydrogen Atom in Excited States. Matsuzawa, M. 1973.

In Radiological and Environmental Research Division annual report: radiation physics, July 1972–June 1973.

Numerical data on the generalized oscillator strength (GOS) of the hydrogen atom with principal quantum numbers 10 and 20 are given in tabular form. The Bethe surface of the hydrogen atom with principal quantum number 20 is also shown. (4 figures, 2 tables) (auth)

25136 (JINR-P2-7493) INFLUENCE OF THE NUCLEUS MOTION ON THE FINE STRUCTURE OF A HYDROGENIC ATOM. Nyun'ko, N. E.; Tyukhtyaev, Yu. N.; Faustov, R. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

In the framework of the quasipotential method the influence of the two-photon exchange on the fine structure of energy levels of a hydrogenic atom is considered for the case of pointlike particles with arbitrary masses. (auth)

25137 (NRL-7599) ATOMIC AND IONIC EMISSION LINES BELOW 2000 ANGSTROMS: HYDROGEN THROUGH KRYPTON. Kelly, R. L.; Palumbo, L. J. (Naval Research Lab., Washington, D. C. (USA)). Jun 1973. 1001p. GPO $11.45.

A critical tabulation is given of 34,700 spectral lines below 2000 angstroms prepared primarily from information in the literature published up to May 1972 and from a few publications after that date. The spectra of atoms and ions for the first 36 elements from hydrogen through krypton are included. (JFP)

25138 PERTURBATION THEORIES FOR THE CALCULATION OF MOLECULAR INTERACTION ENERGIES. II. APPLICATION TO H_2^+. Chipman, D.M.; Hirschfelder, J.O. (Theoretical Chemistry Institute, University of Wisconsin, Madison, Wisconsin 53706). J. Chem. Phys. 59: No. 6, 2838-2857 (15 Sept 1973).

The many perturbation expansions reviewed in Paper I [D. M. Chipman, J. D. Bowman, and J. O. Hirschfelder, J. Chem. Phys. 59, 2830 (1973)] are applied to the interaction of a ground state hydrogen atom with a proton to form the $1s\sigma_g$ and $2p\sigma_u$ electronic states of H_2^+. The calculations were made with high precision for the range of separations $R = 0.2$–$15a_0$ using a large basis set of Slater–type orbitals. For the polarization and symmetrized polarization methods the energies were obtained analytically, these results providing a check on the completeness of the basis set. Also, long range and short range asymptotic formulas are given for the first order wavefunctions and the perturbation energies. The HS and MSMA methods gave the best second order energies. The EL–HAV second order energy is good at intermediate separations but becomes bad at large separations. The expectation value of the Hamiltonian using the wavefunction truncated after the first order (where the coefficient of the zero order function is energy optimized) gave very good results in the OPT, COR, CH, HAV, EL, HS, DEM–I, AM, and SYM–P methods in the order listed; the MSMA and P results were poor due to the use of unsymmetrized wavefunctions. The OPT treatment, which energy optimizes the coefficients of three separate first order functions, has an error of less than 0.04 kcal/mole for the $2p\sigma_u$ state, over the full range of separations, and for the $1s\sigma_g$ state has an error of only 1.4 kcal/mole at the equilibrium separation $R = 2a_0$, becoming much better than this at larger separations. Reasonably good interaction energies can be calculated from the polarization function $\phi_p^{(1)}$ without using the auxiliary functions θ and ω. In the limit of large separations, we find that the EL–HAV second order energy approaches $41/54 = 0.759...$ times the exact Coulombic energy, rather than the previously estimated factor of one–half. Also, at large R, the SYM–P, HS, and DEM–I exchange energy agrees with Herring's exact asymptotic expression to within 0.1%. (auth)

25139 ELECTRON-TRANSFER BANDS IN THE ABSORPTION SPECTRUM OF $CfCl_3$. Nugent, L. J. (Transuranium Research Laboratory, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). J. Chem. Phys.; 59: No. 6, 3440-3441(15 Sep 1973).

Systematics correlating the energies of the corresponding first f–d bands for the actinide trichloride series have shown an apparent inconsistency for the case of $CfCl_3$. It is shown that this arises because the broad bands in question are in fact electron-transfer bands rather than f–d bands, and thus should not follow the systematics of the first f–d band energies. (2 figures) (RWR)

25140 MANY-ELECTRON THEORY IN THE EXTERNAL ELECTRIC FIELD. Labzovskii, L. N. Vestn. Leningrad. Univ., Fiz., Khim.; No. 10, 19-26(May 1973). (In Russian).

The relativistic theory of one- and two-electron ions with the arbitrary charge $1 \leq Z \leq 137$ in the external electric field is developed. An analytic expression for the ground state polarizability of the hydrogenlike ions with the arbitrary Z is derived with the aid of the relativistic Green's function for the electron in the Coulomb field. The Stark effect in multicharged heliumlike ions is also discussed. (auth)

25141 AVERAGE ENERGIES, W, REQUIRED TO FORM AN ION PAIR IN LIQUEFIED RARE GASES. Takahashi, T.; Konno, S.; Doke, T. (Inst. of Physical and Chemical Research, Wako, Japan). J. Phys., C (London); 7: No. 1, 230–240(7 Jan 1974).

The average energies, W, required to form an ion pair in liquid argon, krypton and xenon were determined by measuring steady conduction currents produced by a ^{63}Ni β-source and are found to be 23.7 ± 0.7, 20.5 ± 1.5 and 16.4 ± 1.4 eV, respectively, which are clearly lower than the corresponding W-values in the gaseous state. The W-value of liquid argon obtained by the present experiment is in good agreement with that obtained recently by the pulse method. Applying Platzman's theory, W-values of the liquid rare gases are explained by the band-gap energies or by the polarization energies which are assumed to be nearly equal to those of the solid rare gases. The extrapolation method, often used to evaluate W-values in the liquid state is also discussed. (auth)

25142 QUENCHING OF THE $c\ ^3\Pi_u$ METASTABLE STATE OF H_2 AND D_2 BY AN ELECTRIC FIELD. Johnson, C.E. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. A 9: No. 1, 576-577 (Jan 1974).

The quenching of the $v = 0$ $c\ ^3\Pi_u$ metastable state of H_2 and D_2 by a static electric field has been measured using the time–of–flight technique. Neutral ground–state molecules effusing from a source slit are immediately excited to the $c\ ^3\Pi_u$ metastable state by a pulse of antiparallel magnetically focused electrons. After passing through a uniform electric field region 0.5 m long, the velocity distribution of this thermal beam of metastable molecules is then preferentially detected at the end of the time–of–flight region, 1.825 m from the electron gun. The number of $c\ ^3\Pi_u$ molecules arriving at the detector in specific velocity intervals with the electric field off is compared to the number with the field on, to determine the quenching rate ($= kE^2$). The result for the quenching constant k is the same for both para– and ortho–H_2, as well as for D_2, and with E in kV/cm is $k = 8.6 \pm 0.3$. (auth)

25143 ELECTRON–EXCITATION ENERGY–DEPENDENT FEATURES IN THE M-SERIES X-RAY SPECTRUM OF LANTHANUM. Liefeld, R.J.; Burr, A.F.; Chamberlain, M.B. (Physics Department, Box 3D, New Mexico State University, Las Cruces, New Mexico 88001). Phys. Rev. A 9: No. 1, 316-322 (Jan 1974).

M–series (14 to 15 Å) x–ray spectra from lanthanum are presented for near–threshold electron excitation. Several structures in the spectra which are not the ordinary characteristic–x–ray lines exhibit very strong intensity and wavelength (energy–position) dependence on the energy of the exciting electrons. Consideration of a sequence of spectra recorded for closely spaced ($\Delta E = 1$ eV) incident electron energies and of the shape of the continuum–limit spectrum from lanthanum for other energies show that the several structures are actually a single feature of the continuous spectrum. This linelike feature exactly follows the energy of the incident electrons and has large intensity resonances in the neighborhoods of the threshold excitation energies of the lanthanum M_5 and M_4 inner levels. The interpretation offered suggests that the observed spectral variations are due to resonances in the cross section for scattering incident electrons into vacant 4f levels and that these resonances exist because of the excitation of sets of excited negative–ion bound states involving 3d inner–shell electrons. Consequences of the observed spectral variations for valence–band x–ray spectroscopy, appearance–potential spectroscopy, and continuum–limit spectroscopy are discussed. (auth)

25144 AN ANALYTIC APPROACH TO THE HYDROGEN STARK EFFECT IN WEAK, STRONG, AND ULTRASTRONG FIELDS. Fauchier, J.; Dow, J.D. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana–Champaign, Urbana, Illinois 61801). Phys. Rev. A 9: No. 1, 98-107 (Jan 1974).

An accurate analytic approximate solution of the hydrogen–Stark–effect Schrödinger equation is obtained. In contrast to previous non–numerical solutions, this solution (which is piecewise continuous, and easily calculable) is accurate for applied electric fields of arbitrary strength—including weak fields ($F \lesssim 0.1 F_{ion}$; the Stark–shift regime), strong fields ($F \lesssim F_{ion}$), and ultrastrong fields ($F \gtrsim 10^2 F_{ion}$), where $F_{ion} = 3 \times 10^8$ V/cm is the classical ionization field of hydrogen. The ultrastrong–field regime is experimentally accessible in solid–state physics where, for hydrogenic excitons, F_{ion} may be as small as 10^3 V/cm. (auth)

25145 DIPOLE OSCILLATOR STRENGTHS, WITH RIGOROUS LIMITS OF ERROR, FOR He AND Li^+. Anderson, M.T.; Weinhold,

F. (Department of Chemistry, Stanford University, Stanford, California 94305). Phys. Rev. A 9: No. 1, 118-128 (Jan 1974).

Rigorous upper and lower bounds to dipole oscillator strengths have been calculated for 17 of the low–lying singlet and triplet transitions in He and Li^+ using accurate Hylleraas–type wave functions of some 135–138 terms. About a third of the calculated f values can be guaranteed to 1% or better, and in the best case (Li^+ 2 $^3S \rightarrow$ 2 ^3P) the bounds tighten to about 0.05%, some two orders of magnitude better than corresponding experimental determinations. By comparing with an extensive compilation of experimental results, we find the quality of the rigorous bounds generally to match or exceed that of experimental determinations, and about a dozen experiments can be ruled out entirely. Trends with respect to nuclear charge, spin multiplicity, and principal quantum number are examined, and special emphasis is given throughout to sources of uncertainty in the calculated oscillator strengths which are revealed by the error–bound formulas. (auth)

25146 ANGULAR CORRELATIONS BETWEEN K AND L X RAYS IN THE Nd AND Tb ATOMS. Catz, A.L. (Department of Physics, University of Massachusetts at Boston, Boston, Massachusetts 02116); Macias, E.S. Phys. Rev. A 9: No. 1, 87-92 (Jan 1974).

Angular correlations between K and L x–rays in Nd and Tb were measured. The Nd and Tb x–rays were obtained from radioactive sources of ^{145}Pm and ^{159}Dy, respectively. The K and L x–rays were detected with cooled Ge(Li) and Si(Li) detectors, respectively. The following values were obtained for the coefficient A_{22} in the angular–correlation function $W(\theta) = 1 + A_{22}P_2(\cos\theta)$: for the $K\alpha$–$L\alpha_1$ + $L\alpha_2$ cascade $(2.7 \pm 0.3) \times 10^{-2}$ in Nd and $(2.6 \pm 0.5) \times 10^{-2}$ in Tb; for the $K\alpha$–$L\beta$ cascade $(0.5 \pm 0.4) \times 10^{-2}$ in Nd and $(-0.1 \pm 0.5) \times 10^{-2}$ in Tb; for the $K\alpha$–Ll cascade $(15 \pm 3) \times 10^{-2}$ in Nd and $(14 \pm 5) \times 10^{-2}$ in Tb. The agreement of these results with theory is good only for the $K\alpha$–$L\alpha_1$ + $L\alpha_2$ cascade. (auth)

25147 AUTOIONIZATION STATES IN He AND H^- BY THE STABILIZATION METHOD. Bhatia, A.K. (National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Maryland 20771). Phys. Rev. A 9: No. 1, 9-11 (Jan 1974).

The stabilization method for positions and widths of resonances has been applied up to now only to model problems or to problems for which definitive calculations are not possible. The purpose of this paper is to examine the method for autoionization states in He and H^-, where accurate calculations are available. It is concluded that reasonably accurate results can be obtained by this method. (auth)

25148 VIBRATIONAL RELAXATION OF DEUTERIUM AT 300°K. Lukasik, J. (Laboratoire d'Optique Quantique du C.N.R.S., Bâtiment 503, Campus Universitaire, 91 Orsay, France); Ducuing, J. J. Chem. Phys. 60: No. 1, 331-332 (1 Jan 1974).

The tunable Raman excitation technique was used to study the room temperature vibrational relaxation of D_2 pure and in mixtures with HD, H_2, ^{3}He, ^{4}He and Ar. The results are compared to existing experimental and theoretical data. (AIP).

25149 HIGH–DENSITY STARK PROFILES OF TWO NEUTRAL HELIUM LINES AND THEIR FORBIDDEN COMPONENTS. Greig, J.R.; Jones, L.A. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742); Lee, R.W. Phys. Rev. A 9: No. 1, 44-51 (Jan 1974).

Measured and calculated profiles are compared for the two neutral helium lines, He I (λ = 4471 and λ = 6678 Å) and their forbidden components at electron densities between 1.6×10^{17} and 4.4×10^{17} cm^{-3}. The partially ionized helium plasma was created in the reflected shock of an electromagnetically driven T tube. The electron temperature was measured as ~25 000 °K. The calculated profiles include a random–phase approximation for the electrons to second–order in the frequency–dependent shift and width operators, and the quasistatic approximation for the ions. Calculations were done at the measured plasma conditions and are compared directly with the experimental profiles. Agreement between theory and experiment is good even though in this density range the line He I (λ = 6678 Å) passes from the "isolated–line" to the "overlapping–line" regime, while the line He I (λ = 4471 Å) passes from the "overlapping–line" to the "degenerate–hydrogenic" regime. (auth)

25150 OFF-DIAGONAL HYDROGENIC r^k INTEGRALS BY A LADDER-OPERATOR PROCEDURE. Bessis, N.; Bessis, G.; Hadinger, G. (Univ., Lyon, Villeurbane, France). Phys. Rev., A; 8: No. 5, 2246-2248(Nov 1973).

It is shown that, by applying an "accelerated" or "multi-step" ladder-operatorial procedure, one can obtain, easily, a symmetric closed-form expression for the off-diagonal ($n \neq n'$, $l \neq l'$) hydrogenic r^k matrix elements. (auth)

25151 ELECTRON WAVE FUNCTIONS AT THE NUCLEAR SURFACE. Ogata, H.; Asai, J. (Univ. of Windsor, Ont.). Phys. Lett.; 48B: No. 2, 91-94(21 Jan 1974).

Finite size corrections of Bhalla and Rose are examined in the midway to the point-nucleus limit. A possible reason of poor convergence of their positron wave functions is suggested. (auth)

25152 EXCESS ANGULAR MOMENTUM IN N DIMENSIONS. King, G. M. (Univ. of Lancaster, Eng.). J. Phys., A (London); 7: No. 2, 202-208(21 Jan 1974).

A modified form of excess angular momentum is introduced into both the n dimensional hydrogen atom and the harmonic oscillator. The degeneracies of the new energy levels are shown to be simply related to the representations of 0(n + 1) and SU(n), and in one case this is explained by decomposing the excess system into the direct sum of similar normal systems. (auth)

25153 DISTORTION OF ATOMIC ORBITALS WITHIN MOLECULES. Bauschlicher, C. W. Jr.; Schaeffer, H. F. III. (Univ. of California, Berkeley). Chem. Phys. Lett.; 24: No. 3, 412-415 (1 Feb 1974).

The importance of the flexibility of atomic orbitals in a molecular environment was investigated for several phosphorous containing diatomic molecules. The results indicate the degree to which atomic Hartree–Fock orbitals are suitable for molecular electronic structure studies. (auth)

25154 ELECTRON-COUPLED NUCLEAR SPIN–SPIN INTERACTIONS IN HYDROGEN AND ITS ISOTOPOMERS. Raynes, W. T.; Riley, J. P. (Univ. of Sheffield, Eng.). Mol. Phys.; 27: No. 2, 337-343(Feb 1974).

Theoretical values of the bond-length dependence of the nuclear spin-spin coupling J(HD) in the HD molecule were obtained by Schulman and Kaufman (J. Chem. Phys.; 57: 2328(1972)). Although scope exists for their improvement they are the only results available and are sufficiently close to the true values to justify the making of predictions of the coupling in the isotopomers of HD and the temperature dependences of the coupling in these compounds. HT appears to be the most promising compound to study experimentally, and the predicted spin-spin coupling increase of about 1.5 Hz on increasing the temperature from 100 to 450°K should be measurable. The negative isotope effect on the reduced spin-spin coupling of the hydrogen molecule predicted theoretically is of the same sign as that suggested for primary isotope effects from experimental investigations. (auth)

25155 SINGLET–TRIPLET DIFFERENCES IN THE LOWEST PI_u STATES OF H_2. Colburn, E. A. (Oxford Univ.). J. Phys., B (London); 6: No. 12, 2618-2624(Dec 1973).

A study of the energy differences between the $^1\Pi_u$ and $^3\Pi_u$ states of H_2 was undertaken, and differences in kinetic energies, electron-nuclear attraction energies, and interelectronic repulsion energies are also given for a range of internuclear separations $0.5\ au \leq R \leq 5.0\ au$. Wave functions for both states were calculated as part of the study, using a basis set of twenty Slater-type orbitals to do a self-consistent-field calculation followed by configuration interaction. Optimized exponents were used for the most important orbitals at each internuclear separation. It was found that the interelectronic repulsion energy of the triplet is greater than that of the singlet, and that the triplet lies lower in energy because of its greater electron-nuclear attraction energy. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

25156 (COO-30001-55) NEW INTERPRETATION OF THE PION—NUCLEUS OPTICAL POTENTIAL FOR PIONIC ATOMS. Barshay, S.; Brown, G. E.; Rho, M. (State Univ. of New York, Stony Brook (USA)). 1973. Contract AT(11-1)-3001. 11p. Dep. NTIS $3.00.

It is shown that if the P-wave interaction volumes relevant for construction of the pion-nucleus optical potential used in pionic atom studies turn out to be simply related empirically to the free-space pion-nucleon scattering volumes, then this would be indicative of both sets of quantities being dominated by the Δ(1236 MeV), which is to be treated as an independent baryonic excitation in nuclei. Within this framework, a simple derivation of modifications to the optical potential coming from baryon-baryon short-range correlations is given. (auth)

25157 EFFECT OF THE LONGITUDINAL MAGNETIC FIELD ON THE MUON POLARIZATION IN A MESIC ATOM. Tammet, E. (Inst. of Cybernetics, Tallin). Izv. Akad. Nauk Est. SSR, Fiz. Mat.; 22: No. 4, 425-430(1973). (In Russian).

The external magnetic field influence on muon polarization in mesic atoms with uncompensated moment of electron shell was studied. The electron shell of the system is described by orbital and spin moments. The expression for muon polarization is compared with that in the previous work where the electron shell was characterized by total moment. The results coincide if fine splitting is greater than Zeeman splitting. Strong muon polarization dependence on magnetic field and Hamiltonian interaction constants is presented. (auth)

25158 MUONIUM CHEMISTRY IN LIQUIDS: EVIDENCE FOR TRANSIENT RADICALS. Brewer, J.H.; Crowe, K.M.; Gygax, F.N.; Johnson, R.F. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720); Fleming, D.G.; Schenck, A. Phys. Rev. A 9: No. 1, 495-507 (Jan 1974).

Polarized positive muons are stopped in solutions in magnetic fields transverse to their polarization. Positrons from the asymmetric decay are detected as the muons precess, allowing measurement of the magnitude and direction (phase) of the apparent initial polarization P_{res}. Variations of P_{res} with reagent concentration are compared with theoretical predictions. Measurement of both magnitude and phase of P_{res} allows sensitive tests of the mechanism of "fast" μ^+ depolarization. Evidence is found for both epithermal "hot-atom" reactions and chemical reactions of muonium involving formation of rapidly reacting radicals. Chemical rate constants are extracted and compared with rates for analogous reactions of atomic hydrogen. (auth)

25159 STUDY OF THE ELECTRON DONOR-ACCEPTOR PROPERTIES OF DIAMAGNETIC ORGANIC MOLECULES VIA POSITRONIUM REACTIONS. Madia, W.J.; Nichols, A.L.; Ache, H.J. (Department of Chemistry, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061). J. Chem. Phys. 60: No. 1, 335-336 (1 Jan 1974).

Rate constants for the interactions of positronium with nitrobenzene of ortho, meta and para derivatives of nitrotoluene and dinitrobenzene in benzene solutions are reported. Distinct differences in the rate constants for the reaction of positronium with the organic molecules were observed for the various systems and an attempt was made to correlate these changes to certain molecular parameters and to the effects of steric interactions in these molecules. (AIP)

25160 SURFACE TENSION DEPENDENCE OF THE PICK-OFF ANNIHILATION RATE AND THE BUBBLE MODEL OF THE POSITRONIUM FORMATION. Levay, B.; Vertes, A. Magy. Kem. Foly.; 79: No. 12, 538-540(Dec 1973). (In Hungarian).

Some conclusions are drawn from a comparison of the empirically found surface tension dependence of the pick-off annihilation rate in molecular liquids to the theoretically derived formulas of the bubble model. A simple semiempirical method is suggested to estimate the depth of the potential well for positronium atoms in molecular liquids. The depth of the potential well seems to be proportional to the number of valence electrons per unit volume. (auth)

25161 RELATIONSHIP BETWEEN THE ORTHOPOSITRONIUM ANNIHILATION RATE AND THE SURFACE TENSION IN LIQUIDS AND LIQUID MIXTURES. Levay, B.; Vertes, A.; Hautojarvi, P. Magy. Kem. Foly.; 79: No. 12, 524-528(Dec 1973). (In Hungarian).

The empirical relation between the pick-off quenching rate and the surface tension, discovered by Tao was found to hold also for binary liquid mixtures, such as water-methanol and water-dioxane. The pick-off quenching rate can be correlated with the parachor. This relation proved to be useful in deriving other simple relations between the pick-off quenching rate and temperature or viscosity. Furthermore, it resulted in a new additivity rule, which proved to be valid not only for simple molecular liquids but their binary mixtures as well. (auth)

Collision Phenomena

Refer also to abstracts 25135, 25138, 25143, 25212, and 25387.

25162 (ANL-8060(Pt. 1)) RADIOLOGICAL AND ENVIRONMENTAL RESEARCH DIVISION ANNUAL REPORT: RADIATION PHYSICS, JULY 1972–JUNE 1973. (Argonne National Lab., Ill. (USA)). 1973. Contract W-31-109-eng-38. 243p. Dep. NTIS $7.60.

Work of the following three types is reported: electron scattering by atoms and molecules, photoabsorption and photoionization processes, and pertinent theoretical studies. All efforts were aimed at the elucidation of elementary mechanisms of interaction between radiation and matter; more specifically, all the programs were designed to produce key elements needed in predicting the yields of primary species formed in molecular substances subjected to ionizing radiation. Papers in the report deal with the following subjects: methods for predicting the yields of primary species from cross-section data, inelastic collisions of fast charged particles, photoionization processes, slow-electron collisions and closely related phenomena, and other theoretical studies. Separate abstracts were prepared for nine of the papers in the report. (RWR)

For abstracts of individual papers see: 24231, 25134, 25135, 25163–25167, and 25212.

25163 (ANL-8060(Pt. 1), pp 14-23) INCOHERENT-SCATTERING FUNCTIONS AND THE BETHE CROSS SECTIONS FOR Ne AND Ar. Kim, Y. K.; Naon, M.; Cornille, M. 1973.

In Radiological and Environmental Research Division annual report: radiation physics, July 1972–June 1973.

Incoherent-scattering functions of Ne and Ar calculated from the Bethe–Goldstone method are presented. These functions are used, in turn, to evaluate parameters for the Bethe cross sections for total inelastic scattering of fast charged particles by Ne and Ar. The cross section for Ne is in close agreement with that by Saxon. For Ar, most experimental data on ionization by electron impact are in agreement (within 10%) with the tentative Bethe cross section for ionization. (3 figures, 2 tables) (auth)

25164 (ANL-8060(Pt. 1), pp 55-73) OPTICAL MODEL FOR THE ENERGY DISTRIBUTION OF SECONDARY ELECTRONS. Kim, Y. K. 1973.

In Radiological and Environmental Research Division annual report: radiation physics, July 1972–June 1973.

A striking similarity between the experimental data on the production of secondary electrons by electron impact and the photoionization cross section is demonstrated for the rare gases and some molecules. Present study shows that the Mott cross section could serve as an approximate base cross section to which scaled optical data and the Auger electron spectrum are added to reproduce all qualitative features observed in the electron-impact data. An empirical criterion is proposed to normalize the secondary-electron data to the Mott cross section in the region of the secondary-electron energies where the shape of the measured cross sections resembles the theoretical one very closely. For incident electrons of 500 eV kinetic energy, secondary-electron energies of 150 to 200 eV appear to be the appropriate region for such a normalization procedure. According to the proposed scheme, for instance, the data on He by Peterson, Beaty, and Opal (at 500 eV incident energy) should be reduced by ~20%. The binary-encounter theory, which includes the momentum distribution in the initial state of the target, tends to overestimate the cross section, particularly for heavy atoms. (16 figures, 3 tables) (auth)

25165 (ANL-8060(Pt. 1), pp 198-204) APPARATUS FOR STUDYING RESONANCES IN THE SCATTERING OF ELECTRONS BY FREE RADICALS. Observation of the H^- (n = 3) ^1D Resonance. Spence, D.; Steingraber, O. J. 1973.

In Radiological and Environmental Research Division annual report: radiation physics, July 1972–June 1973.

An apparatus for studying resonances in the total cross section for scattering of electrons by free radicals was constructed. Factors governing dissociation in free radical sources are discussed, and preliminary results on the observation of the H^- (n = 3) ^1D states are presented. (3 figures) (auth)

25166 (ANL-8060(Pt. 1), pp 205-209) RESONANCES IN THE TOTAL CROSS SECTION FOR SCATTERING OF ELECTRONS BY ATOMIC OXYGEN. Spence, D.; Chupka, W. A. 1973.

In Radiological and Environmental Research Division annual report: radiation physics, July 1972–June 1973.

By using an electron-scattering technique, two new resonant states of O^- were located at 8.80 eV and 14.06 eV. In addition, the existence of four other resonances previously observed in ion–neutral collision experiments was verified. An electron configuration $2p^3(^4S)3s^2(^4S)$ has been assigned to the new O^- state at 8.80 eV. (1 figure, 1 table) (auth)

25167 (ANL-8060(Pt. 1), pp 210-215) CORE-EXCITED RESONANCES IN H_2^-. Spence, D. 1973.

In Radiological and Environmental Research Division annual report: radiation physics, July 1972–June 1973.

The effect of the retarding potential used in electron-transmission spectroscopy on the observed resonance profiles in H_2 was studied. By careful selection of this retarding potential, the visibility of the "c" series of core-excited resonances in the region of 11.0 to 13.0 eV was enhanced, and thereby the existence of an additional member of this series at 11.20 eV was verified. This observation necessitates increasing previously accepted vibrational quantum numbers of this series by unity. (1 figure, 1 table) (auth)

25168 (CEA-CONF-2441) USE OF A TUBULAR MULTIPLIER IN COUNTING MEASUREMENTS WITH A CONDENSED MOLECULAR JET. Le Bihan, A. M.; Bottiglioni, F.; Coutant, J.; Fois, M. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee). 1973. 8p. (In French). (CONF-730738–1). Dep. NTIS (U. S. Sales Only) $3.00.

From fourth international symposium on molecular jets; Cannes, France (9 Jul 1973).

A tubular multiplier was used for counting measurements in studies of the cross sections for granion production encountered in reactions occurring in molecular jets produced by electron bombardment. (auth)

25169 CROSSED-BEAM STUDIES OF THE HYDROGEN EXCHANGE REACTION: THE REACTION OF H ATOMS WITH T_2 MOLECULES. Kwei, G.H.; Lo, V.W.S.; Entemann, E.A. (Department of Chemistry, State University of New York, Stony Brook, New York, 11790). J. Chem. Phys. 59: No. 6, 3421-3422 (15 Sept 1973).

Complete in-plane laboratory (LAB) angular distributions of T atoms have been measured. The T atoms were found in the exchange reaction $H + T_2 \rightarrow HT + T$. (AIP)

25170 DETACHMENT OF ELECTRONS FROM F^- BY F, O_2 AND O. Mandl, A. (Avco Everett Research Laboratory, Inc., Everett, Massachusetts 02149). J. Chem. Phys. 59: No. 6, 3423-3424 (15 Sept 1973).

A series of detachment rates of electrons from F have been measured in a CaF seeded shock tube. Temperature dependence of detachment rates is reported. (AIP)

25171 TESTS OF APPROXIMATE METHODS FOR THE CALCULATION OF THE STATIC POTENTIAL FOR ELECTRON SCATTERING BY CO. Truhlar, D.G.; Van-Catledge, F.A. (Department of Chemistry, University of Minnesota, Minneapolis, Minnesota 55455). J. Chem. Phys. 59: No. 6, 3207-3213 (15 Sept 1973).

The interaction potential between an electron and an unperturbed CO molecule is calculated as a function of the electron's position $\vec{r}$ (measured with the origin at the center-of-mass of CO) by the INDO (intermediate-neglect-of-differential-overlap) molecular orbital theory and by an approximate application (following Itikawa and Takayanagi) of Massey's method. The results are compared quantitatively to the ab initio extended-basis-set molecular orbital calculation of Gianturco and Tait. The potential is expanded as $V(\vec{r}) = \Sigma_L V_L(r)P_L(\hat{r}\cdot R)$, where R is a unit vector along the internuclear axis. The INDO $V_L(r)$ is fairly accurate for $L = 0$, 2, and 4 but not for $L = 1$. The approximate Massey's method calculation is fairly accurate only for $r < 2.3$ bohr for $L = 0$, 2, and 4. (auth)

25172 ELECTRON AFFINITIES FROM ENDOTHERMIC NEGATIVE-ION CHARGE-TRANSFER REACTIONS. III. NO, NO_2, SO_2, CS_2, Cl_2, Br_2, I_2, AND C_2H_2. Hughes, B. M.; Lifshitz, C.; Tiernan, T.O. (Aerospace Research Laboratories, Chemistry Research Laboratory Wright-Patterson Air Force Base, Ohio 45433). J. Chem. Phys. 59: No. 6, 3162-3181 (15 Sept 1973).

Translational energy thresholds have been measured for electron transfer reactions from various atomic negative ions to NO, NO_2, SO_2, CS_2, Cl_2, Br_2, I_2, and C_2H_2 using a tandem mass spectrometer. These thresholds, corrected where necessary for thermal broadening, were utilized with known thermodynamic data to calculate electron affinities for the molecules indicated. These results were also shown to be consistent with electron affinity limits established by observations of certain exothermic reactions of the molecular negative ions. The isotope distributions in the products from the reactions of monoisotopic Cl^- and Br^- with natural Cl_2 and Br_2, respectively, suggest that these reactions proceed via a linear X_3^- intermediate in which good "mixing" of the available energy occurs. The implications of this model with respect to the significance of the measured energy thresholds is discussed. (auth)

25173 PENNING AND ASSOCIATIVE IONIZATION OF TRIPLET METASTABLE HELIUM ATOMS. Garrison, B.J.; Miller, W.H. (Inorganic Materials Research Division, Lawrence Berkeley Laboratory, and Department of Chemistry, University of California, Berkeley, California 94720); Schaefer, H.F. J. Chem. Phys. 59: No. 6, 3193-3198 (15 Sept 1973).

Potential energy curves for the $^1\Sigma_g^+$, $^3\Sigma_u^+$, and $^5\Sigma_g^+$ states which arise from two triplet metastable helium atoms ($1s2s\,^3S$) have been calculated by a large configuration interaction expansion. From the potential curves for the $^1\Sigma_g^+$ and $^3\Sigma_u^+$ autoionizing states, cross sections for Penning and associative ionization have been calculated; the total ionization cross section for thermal energy (0.026 eV) collisions, for example, is computed to be 94 Å^2. In this low energy region the orbiting model is seen to be adequate for determining the total ionization cross section, but not the more specific cross sections. (auth)

25174 CLASSICAL CALCULATIONS OF ROTATIONAL AND VIBRATIONAL EXCITATION IN ENERGETIC ATOM-DIATOMIC HYDRIDE COLLISIONS. Tait, K.S.; Kolb, C.E.; Baum, H.R. (Aerodyne Research, Incorporated, Burlington, Massachusetts 01803). J. Chem. Phys. 59: No. 6, 3128-3137 (15 Sept 1973).

Classical rotational excitation probabilities for collisions of HF, HCl, and OH with three atomic species have been calculated in three dimensions using a Monte Carlo procedure. Results are presented for the rotational excitation of both rigid diatomic rotors and those coupled via a classical harmonic oscillator. Hard-sphere intermolecular potentials were employed to obtain results applicable to high-energy (≥ 1 eV) collisions. (auth)

25175 REACTION PATHS ON THE H_4 POTENTIAL ENERGY SURFACE. Silver, D.M. (Applied Physics Laboratory, The Johns Hopkins University, Silver Spring, Maryland 20910); Stevens, R.M. J. Chem. Phys. 59: No. 6, 3378-3394 (15 Sept 1973).

Portions of the electronic potential energy surface corresponding to various nuclear geometries of the H_4 molecular system have been studied. The variational calculations employed double-zeta basis sets (1s and 1s' Slater-type orbitals on each center) to form configuration interaction wavefunctions. At selected points on the surface, the effects of exponent optimization and increased basis set size (1s, 1s', and 2p orbitals per center) were assessed. A low energy reaction path allowing a bimolecular mechanism for exchange, requiring less energy than a single H_2 dissociation, was not found. However, a path leading from trapezoidal to linear structures (and vice versa) was found to offer the possibility of exchange with less than 6 kcal/mole of energy above this dissociation limit. (auth)

25176 COUPLED INTEGRAL-EQUATION APPROACH TO NONRELATIVISTIC THREE-BODY SYSTEMS WITH APPLICATIONS TO ATOMIC PROBLEMS. Chen, J. C. Y. (Univ. of California, San Diego, La Jolla). Case Stud. At. Phys.; 3: No. 5, 305-417(Jul 1973).

The coupled integral-equation approach to nonrelativistic three-body systems is reviewed. After examining the relations among various coupled equations, the problems of reducing these coupled equations to forms which are suitable for practical applications are considered. For three-body Coulomb systems, alternative approaches are proposed for treating the long-range Coulomb interaction. Approximate methods for solving these coupled equations are then examined with illustrative examples in atomic problems. (auth)

25177 THEORY OF THE ENERGY DISTRIBUTION FUNCTION FOR BACKSCATTERED ELECTRONS. Landron, C.; Andreani, M.; Azou, P.; Bastien, P. (Ecole Centrale des Arts et Manufactures, Chatenay-Malabry, France). Compt. Rend., Ser. A, B; 277: No. 14, 359-363(8 Oct 1973). (In French).

The energy distribution of electrons backscattered from thick homogeneous targets was theoretically determined for a 50-keV beam of monoenergetic electrons. The analytical results obtained, which depend, on the incident energy and the atomic number of the target are compared with the experimental data of Kulenkampf and Spyra. (auth)

25178 ELECTRON-HYDROGEN ATOM INTERACTIONS IN THE FRAMEWORK OF THE ADIABATIC APPROXIMATION. Decoster, A.; Fabre, B. (CEN, Villeneuve-Saint-Georges, France). Compt. Rend., Ser. A, B; 277: No. 14, 365-367(8 Oct 1973). (In French).

A new form of interaction potential between an electron and a hydrogen atom is obtained in the framework of the adiabatic approximation. This potential is situated in relation to already known approximations by comparing the low energy phase shifts. (auth)

25179 NEGATIVE-ION ELECTRON DETACHMENT CROSS SECTION. Devdariani, A.Z. (A. A. Zhdanov Leningrad State University). Sov. Phys.-Tech. Phys. 18: No. 2, 255-258 (Aug 1973).

The short-range potential model is used to obtain an equation for the electron detachment cross section for a negative ion. The cross section is a univerial function of a single parameter and, in contrast with expressions used previously, increases with the bombarding energy at energies appreciably above threshold, in agreement with experiment. The expression is used to calculate the H^-+He and H^-+Ne cross sections for $100 \gtrsim E \gtrsim 10^4$ eV. (auth)

25180 CROSS SECTION FOR DISSOCIATION OF H^+_2 AND D^+_2 IONS IN THE ENERGY RANGE 0.1-2 keV. Zhurkin, E.S.; Kaminskii, V.A.; Tikhomirov, M.V.; Tunitskii, N.N. (L. Ya. Karpov Physicochemical Scientific-Research Institute, Moscow). Sov. Phys.-Tech. Phys. 18: No. 2, 259-261 (Aug 1973).

The cross section σ for the dissociation of H^+_2 and D^+_2 ions in the energy range 0.1-0.2 keV are measured on a double mass spectrometer for the following processes: I) $H^+_2(H_2)+H_2–H^++H+H_2$; II) $D^+_2(D_2)+D_2–D^++D+D_2$; III) $D^+_2(D_2)+Ne–D^++D+Ne$; IV) $D^+_2(CD_4)+Ne–D^++D+Ne$. The symbol in parentheses indicates the material from which the ions are formed by electron impact. It is shown that for the weakly excited $H^+_2(H_2)$ and $D^+_2(D_2)$ ions (processes I-III) σ increases with kinetic energy; for highly excited $D^+_2(CD_4)$ ions (process IV) it decreases. These results are interpreted on the assumption that dissociation by momentum transfer to the nucleus plays a more significant role in process IV. The kinetic energy of the dissociation products is discussed for two mechanisms: excitation of repulsive electron states and momentum transfer to the nucleus. (auth)

25181 RIGOROUS PRECISION p-WAVE POSITRON-HYDROGEN SCATTERING CALCULATION. Bhatia, A.K.; Temkin, A.; Eiserike, H. (National Aeronautics and Space

Administration, Goddard Space Flight Center, Theoretical Studies Branch, Greenbelt, Maryland 20771). Phys. Rev. A 9: No. 1, 219-222 (Jan 1974).

Rigorous lower-bound p-wave positron-hydrogen phase shifts are calculated below the positronium pick-up threshold. The wave function is expanded in terms of the two linearly independent *D* functions each multiplied by an associated Hylleraas-type radial function with two nonlinear parameters. Calculations have been done employing up to a total of 168 linear parameters, so that convergence can be examined and extrapolations could in most cases be performed to N = ∞. In addition, adiabatic and nonadiabatic corrections have been included. Results are found to be larger than Armstead's in all cases, near the upper edge of his estimated uncertainty. The calculation confirms as a byproduct that there are no p-wave Feshbach resonances in this energy range. (auth)

25182 POLARIZATION IN DISTANT COULOMB COLLISIONS OF CHARGED PARTICLES WITH ATOMS. Hill, K.W.; Merzbacher, E. (University of North Carolina at Chapel Hill, Chapel Hill, North Carolina 27514). Phys. Rev. A 9: No. 1, 156-165 (Jan 1974).

The inelastic collisions of a heavy fast particle of charge Z_1e, incident at an impact parameter b, with an electron bound in an atom isotropically and harmonically is considered. The "atom" is treated by quantum mechanics, extending an earlier classical calculation by Ashley, Ritchie, and Brandt. A multipole expansion of the Coulomb interaction for distant collisions is used. Two methods are employed to calculate Z_1^3 contributions to the mean energy loss and the excitation probabilities due to dipole and quadrupole terms in the multipole expansion. In one method the dipole interaction is taken into account exactly by applying the quantum formalism of the forced harmonic oscillator, and the quadrupole interaction is treated as a first-order perturbation. The second method of calculation employs both dipole and quadrupole interactions as time-dependent perturbations to second order on the free harmonic oscillator. The energy loss calculated for a particle incident on a straight-line trajectory agrees with the classical calculation. Reasons for this agreement are given. Simplifications of the calculation owing to time-reversal symmetry considerations and selection rules for the harmonic oscillator are discussed. Comments are made concerning the relative importance of distant and close collisions at high and low impact velocities. (auth)

25183 CROSS SECTIONS FOR PRODUCTION OF O_2^- AND C^- BY DISSOCIATIVE ELECTRON ATTACHMENT IN CO_2: AN OBSERVATION OF THE RENNER-TELLER EFFECT. Spence, D. (Argonne National Laboratory, Argonne, Illinois 60439); Schulz, G.J. J. Chem. Phys. 60: No. 1, 216-220 (1 Jan 1974).

Using monoenergetic electron beams and mass analysis, we have measured the cross sections for production of O^-_2 and C^- by dissociative attachment in CO_2. The cross section for O^-_2 production has two peaks of the order of 10^{-24} cm^2 at 11.3 ± 0.2 and 12.9 ± 0.2 eV incident electron energy. The double peaked nature of the cross section is interpreted as a manifestation of the Renner-Teller effect. The positions of these two peaks are in good agreement with INDO calculations. The cross section for C^- production has three peaks at 16.0 ± 0.2, 17.0 ± 0.2, and 18.7 ± 0.1 eV, the largest of which, at 18.7 eV, has magnitude of approximately 2×10^{-21} cm^2. (auth)

25184 FORMATION OF ELECTRONICALLY EXCITED CO_2^+ IN COLLISIONS OF H^+, H, He^+, AND Ne^+ WITH CO_2. Haugh, M.J. (Department of Chemistry, Temple University, Philadelphia, Pennsylvania 19122); Birely, J.H. J. Chem. Phys. 60: No. 1, 264-269 (1 Jan 1974).

Electronic excitation in collisions of 200 eV-25 keV H^+, H, He^+, and Ne^+ with CO_2 has been investigated under single-collision conditions in an atomic beam experiment. For each of these projectiles, the $B^2\Sigma^+_u$ and $A^2\Pi_u$ states of CO_2^+ are the dominant electronically excited species emitting in the 200-500 nm wavelength range owing to target excitation. Although dissociative electron capture by He^+ and Ne^+ to form electronically excited CO^+ minimizes the energy defect, no emission is observed from CO^+ $A^2\Pi$, and formation of $CO^+B^2\Sigma^+$ is of only minor importance. The latter observations are in direct contradiction to predictions derived from the adiabatic criterion and demonstrate that, in the competition among allowed excitation processes, details of the electronic structure of the collision partners override energy considerations. The qualitative features of the emission spectrum excited by H^+, H, and He^+ are insensitive to relative velocity over the energy range covered. The ratio of the cross sections for excitation of CO_2^+ B-X and A-X emissions is about 0.20 for H^+ and 0.40 for He^+. In Ne + impact, the CO_2^+ A state vibrational distribution changes significantly, the (B-X)/(A-X) cross section ratio decreases from 0.46 to 0.07, and the relative importance of Ne and Ne^+ emissions diminishes markedly as the energy is reduced from 4 keV to 200 eV. Our results are compared with those for electronic excitation produced by photoionization, electron impact, and Penning ionization of CO_2. (auth)

25185 LOW-ENERGY ELASTIC SCATTERING OF ELECTRONS BY THE NEUTRAL ARGON ATOM. Pindzola, M.S.; Kelly, H.P. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901). Phys. Rev. A 9: No. 1, 323-331 (Jan 1974).

The cross section for elastic scattering of electrons by neutral argon atoms has been calculated from 0-300 eV. The optical potential, or self-energy of the single-particle Green's function, is used to include effects of electron correlations, which are found to be significant at low energy. The cross section is calculated by means of a partial-wave expansion. Our results are compared with previous calculations and with experiments. Good agreement is obtained with experiment over a wide energy range. (auth)

25186 BETHE SURFACE, ELASTIC AND INELASTIC DIFFERENTIAL CROSS SECTIONS, COMPTON PROFILE, AND BINDING EFFECTS FOR H_2 OBTAINED BY ELECTRON SCATTERING WITH 25 keV INCIDENT ELECTRONS,. Ulsh, R.C.; Wellenstein, H.F.; Bonham, R.A. (Department of Chemistry, Indiana University, Bloomington, Indiana 47401). J. Chem. Phys. 60: No. 1, 103-111 (1 Jan 1974).

Electron impact spectra for H_2 have been obtained at scattering angles of 1 °, 1.5 °, 2 °, 3 °, 4 °, 5 °, 7 °, and 10 ° using 25 keV incident electrons. The measured intensities were converted to generalized oscillator strengths and placed on an absolute scale at each scattering angle by the use of the Bethe sum rule for the generalized oscillator strength distribution. The cross section differential with respect to both solid angle and energy loss of the scattered electron was corrected for relativistic and exchange effects and integrated over energy loss to obtain the inelastic differential cross sections. In addition the elastic cross section differential with respect to solid angle was measured. The results are all in excellent agreement with theoretical calculations. The total elastic cross section was determined using additional data from another source. The Compton profile was determined from the 7 ° scattering data and was found to agree well with the previous x-ray results. Consistent generalized optical sums (2,1,-1,-2) and optical sum inequalities for the generalized oscillator strength were also obtained. In addition inelastic scattering factors were computed from the (-1) optical sum and were found to agree well with available theory. Chemical binding effects were explored using electron density difference functions obtained from the differential cross sections. For the first time the intensity difference functions for the elastic and inelastic scattering were determined separately. It is argued that the experimental method used in this study to obtain the intensity difference functions represents the best approach so far developed for obtaining direct information about molecular real space charge densities. (auth)

25187 ELECTRON CAPTURE INTO THE 3s AND 4s STATES OF ATOMIC HYDROGEN BY H^+ AND D^+ IMPACT ON Ar, He, AND Kr. Dawson, H.R.; Loyd, D.H. (Department of Physics, Angelo State University, San Angelo, Texas 76901). Phys. Rev. A 9: No. 1, 166-170 (Jan 1974).

Cross sections have been determined for electron capture into the 3s and 4s states of atomic hydrogen by proton and deuteron (1.2-8.2 keV) impact on Ar, He, and Kr. The He cross sections both show an exponential increase with energy. Previous structure is confirmed and additional structure is indicated in the 3s cross section for impact on Ar. These data represent the first measurements of the 3s and 4s cross sections for impact on krypton. (auth)

25188 IMPACT-PARAMETER DEPENDENCE OF ATOMIC COULOMB K-SHELL IONIZATION CROSS SECTIONS IN A PEAKED-BINARY-ENCOUNTER APPROXIMATION. McGuire, J.H. (Department of Physics, Kansas State University, Manhattan, Kansas 66506). Phys. Rev. A 9: No. 1, 286-296 (Jan 1974).

Cross sections for the ionization of atoms by the impact of heavy, charged particles are expressed as a function of the impact parameter b of the incident projectile. The ionization probability P(b), which is obtained in a peaked-binary-encounter approximation (BEA), is compared to several recent experiments and to the semiclassical Coulomb approximation (SCA). At high energies the BEA and plane-wave SCA models give the same result, the shape of which is proportional to a simple function of 2b/a (a is the atomic radius). The functional form is independent of both projectile and target for isotropic target-electron distributions. At low energies the BEA and SCA models give similar but not identical results. The scaling properties at low energies are the same for both models. Comparison to experimental results at intermediate energies does not strongly favor either model at this time. Typically, the shape of P(b) is within ~ 50% of experiment. A table of P(b) for the BEA model is given which, together with scaling laws, may be used to find P(b) for arbitrary projectiles and targets at various energies. (auth)

25189 EMISSION CROSS SECTIONS FOR N_2^+ (3914 Å) FOR F^+, Ne^+, AND Na^+ IONS INCIDENT ON N_2 GAS. Hoffman, J.M.; Lockwood, G.J.; Miller, G.H. (Sandia Laboratories, Albuquerque, New Mexico 87115). Phys. Rev. A 9: No. 1, 187-191 (Jan 1974).

Absolute cross sections for the emission of the 3914-Å radiation of the N_2^+ first negative system have been measured by F^+, Ne^+, and Na^+ ions incident on a gaseous nitrogen target. The energy range covered was 30 to 100 keV. It is shown that for incident F^+ and Ne^+ the emission cross sections closely resemble in shape the corresponding charge-transfer cross sections for these ions with N_2. In the case of Na^+ the two cross sections bear little resemblance. These results are consistent with the magnitudes of the internal-energy change required for each of the processes. It is concluded that charge transfer is the dominant process for exciting the B $^2\Sigma$ ($v' = 0$) state in the cases of F^+ and Ne^+, while no such conclusion can be drawn for Na^+. (auth)

25190 CROSS SECTIONS FOR L-SUBSHELL IONIZATION IN Au BY THE COLLISION OF PROTONS AND HELIUM IONS.

Datz, S. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830); Duggan, J.L.; Feldman, L.C.; Laegsgaard, E.; Andersen, J.U. Phys. Rev. A 9: No. 1, 192-196 (Jan 1974).

Absolute ionization cross sections for the L subshells of Au by proton bombardment (0.25–5.2 MeV) have been determined from data obtained using a Si(Li) detector and the presently available values for radiative transition probabilities, fluorescence yields, and Coster–Kronig factors. The measured cross sections are compared with values calculated by Choi using the plane-wave Born approximation (PWBA) with either relativistic or nonrelativistic hydrogenic wave functions for the Au electrons. Except at low energies ($\eta_L/\theta^2_L < 0.2$) where the uncorrected PWBA is questionable, the agreement is good. A plateau in the 2s ionization cross section attributable to the bimodal 2s-electron wave function is observed in the region 0.5–1.0 MeV. Ionization by He ions (1–12 MeV) is similar, but significant differences in subshell behavior are observed. (auth)

25191 L-SHELL IONIZATION OF SURFACE ATOMS BY BACKSCATTERED ELECTRONS.

DuCharme, A.R.; Gerlach, R.L. (Sandia Laboratories, Albuquerque, New Mexico 87115). Phys. Rev. A 9: No. 1, 197-202 (Jan 1974).

Backscattering cross sections for the electron-impact L_1-shell ionization of Na, Mg, and S as well as the $L_{2,3}$-shell ionization of Mg, S, Cl, and Cu are reported. The use of target atoms chemisorbed on a metal surface allow measurement of the weak intensities in the backscattered region. The Burhop first Born approximation theory is shown to qualitatively describe the primary-electron energy dependence of these backscattering ionization cross sections. However, the theoretical cross sections are generally too low, particularly for the highest primary-electron energies studied. (auth)

25192 ANGULAR DISTRIBUTIONS AND POLARIZATION FRACTIONS OF HELIUM RESONANCE RADIATION ($n\ ^1P$–$1\ ^1S$) IN THE EXTREME ULTRAVIOLET.

Mumma, M.J.; Misakian, M.; Jackson, W.M.; Faris, J.L. (Laboratory for Extraterrestrial Physics, NASA/Goddard Space Flight Center, Greenbelt, Maryland 20771). Phys. Rev. A 9: No. 1, 203-208 (Jan 1974).

We present the first experimentally determined angular-intensity distributions of helium ($n\ ^1P$–$1\ ^1S$) resonance photons with respect to the exciting electron beam. The angular-intensity distributions were measured at selected electron-impact energies from 25 eV (near threshold) to 150 eV. Polarization fractions (Π) were obtained by analyzing the data in terms of the theoretical relation between angular-intensity distribution and Π, i.e., $I(\theta) = I(90)(1 - \Pi \cos^2\theta)$. The experimental values for Π are compared with recent theoretical results and with previous experimental values for the ($3\ ^1P$–$2\ ^1S$) transition. Our results are slightly higher than the theoretical results for electron-impact energies from 80 to 150 eV, e.g., 0.36 vs 0.32 at 100 eV. Our values for Π reach a maximum at ~40 eV, where $\Pi = 0.55$, and then decrease for lower electron energies, reflecting the increasing importance of cascade ($m\ ^1S$–$n\ ^1P$) transitions at lower electron energies. (auth)

25193 PRODUCTION OF FAST HIGHLY EXCITED ATOMS IN PROTON COLLISIONS WITH ATOMIC HYDROGEN AND ARGON.

Bayfield, J.E.; Khayrallah, G.A.; Koch, P.M. (Gibbs Laboratory, Yale University, New Haven, Connecticut 06520). Phys. Rev. A 9: No. 1, 209-218 (Jan 1974).

The study of keV H^+–H(1 s) collisions has been extended to the production by electron transfer of highly excited states with principal quantum numbers between 13 and 28. A fast-proton beam was passed through thermally dissociated hydrogen gas, and the resultant fast excited atoms were observed using electric field ionization and proton-counting techniques. The incident proton energy range was from 7 to 60 keV. The observed cross section for production of such excited states possesses a broad maximum near 30 keV. The sum of cross sections over the observed principal quantum numbers is 0.00089 Å^2 at 7 keV, 0.0070 Å^2 at 30 keV, and drops again with energy to 0.0023 Å^2 at 60 keV. Possible error in our cross section scale is ± 30%. Thus the fraction of electron-transfer collisions producing these highly excited states varies from a maximum value of about 0.03% in the range 30–60 keV to the lower value of 0.01% at 7 keV, values not markedly different from those found for inert-gas target atoms; this is contrary to the predictions of the Brinkman–Kramers–Oppenheimer approximation. The data at 60 keV agree with recent calculations by Band using the coupled Born approximation. The present results for H^+–Ar collisions and $13 \le n \le 28$ are in agreement with previous investigations for $9 \le n \le 15$, assuming that the Jackson–Schiff scaling rule is valid for this collision system. (auth)

25194 ANNIHILATION DURING POSITRON-HYDROGEN COLLISIONS.

Bhatia, A.K.; Drachman, R.J.; Temkin, A. (Theoretical Studies Branch, NASA Goddard Space Flight Center, Greenbelt, Maryland 20771). Phys. Rev. A 9: No. 1, 223-225 (Jan 1974).

Using the precision s- and p-wave elastic-scattering wave functions obtained previously, we have calculated the annihilation rate for positrons colliding with hydrogen atoms below the positronium-formation threshold. The s-wave results agree well with those of Humberston, while the p-wave results, which are new, contribute about 20% of the total at the higher energies. (auth)

25195 ADIABATIC APPROXIMATION AND THE OTHER (LOWER) BOUND ON THE SCATTERING LENGTH.

Hahn, Y. (Physics Department, University of Connecticut, Storrs, Connecticut 06268); Spruch, L. Phys. Rev. A 9: No. 1, 226-240 (Jan 1974).

The static approximation, which neglects the distortion of the (complex) target, that is, virtual excitations, during the collision of a particle with the target, was shown previously to give an upper bound on the scattering length when the number of bound states supported by the static and true Hamiltonians are the same. It represents an underadjustment of the target to the field of the scattering particle. It is perhaps then to be expected that the adiabatic approximation, in which the target wave function is calculated for each value of the incident particle coordinate as if the incident particle were fixed at the given point and which represents therefore an overadjustment of the target to the field of the incident particle, might provide the opposite bound, the lower bound, on the scattering length. This possibility is explored for the determination of scattering lengths. The bound property is shown to hold in cases where both the true and adiabatic Hamiltonians support the same number of bound states; some (reasonable) subsidiary conditions must also be satisfied. Possible extensions of the formulation to scattering with nonzero energy and with exchange are briefly mentioned. The theory is then applied to e^+H and e^+He scattering at zero incident energy; a reasonably accurate bound for the latter system is obtained, but the adiabatic approximation gives only a very crude, though rigorous, bound on the e^+H scattering length. A connection between the generalized optical potential and the adiabatic potential is derived using projection-operator techniques, thus further clarifying the physical content of the adiabatic picture. Bounds are also obtained for atom-atom and ion-atom collisions; they are interesting only if the electron-proton mass ratio is not thought of as vanishingly small. Some consideration is given to pH scattering. Lower bounds on electron-atom scattering lengths are more difficult to obtain. (auth)

25196 FORM FACTORS OF THE HYDROGEN ATOM IN EXCITED STATES.

Matsuzawa, M. (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. A 9: No. 1, 241-250 (Jan 1974).

An exact closed expression for the form factor (and hence the generalized oscillator strength) for bound-free transitions of the hydrogen atom in highly excited states is derived by use of the Coulomb Green's function. The calculated densities of the generalized oscillator strength of the excited hydrogen atom with an initial principal quantum number $n_0 = 10$ are 10.9 (−5.0), 13.6 (−4.0), 22.7 (−3.0), 55.3 (−2.0), 96.2 (−1.0), 42.1 (0.0), and 4.63 (1.0) in Ry^{-1} near the ionization threshold [for $E/I(n_0) = 1.0001$]. Here a figure in parentheses denotes the value of $\ln(n^2_0 q^2)$, where q is the magnitude of the momentum transfer, E the excitation energy measured from the state n_0, and $I(n_0)$ the ionization potential. Using these results, we draw the Bethe surface, i.e., a three-dimensional plot of the density of the generalized oscillator strength as a function of E and $\ln q^2$. This surface gives a quantitative understanding for the entirety of the inelastic process of this excited atom by charged particles. The validity of the binary-encounter theory is quantitatively discussed. The Born cross sections for excitations ($n_0 \to n_0 + 1$, $n_0 \to n_0 + 2$, $n_0 \to 2n_0$ transitions) and ionization are evaluated for the case of $n_0 = 10$ and 20. Finally, an application of this form factor to the collisional ionization of the highly excited atom with a molecule is briefly mentioned. (auth)

25197 TIME DEPENDENCE OF THE VACUUM-ULTRAVIOLET EMISSIONS IN KRYPTON EXCITED BY 250-keV ELECTRONS.

Leichner, P. K.; Ericson, R. J. (Department of Physics and Astronomy, University of Kentucky, Lexington, Kentucky 40506). Phys. Rev. A 9:· No. 1, 251-259(Jan 1974).

Time-dependent studies of the vacuum-ultraviolet emissions in krypton were performed using 250-keV electrons. Measurements as a function of pressure were made at the wavelengths of the $^1P_1$ and $^3P_1$ resonance lines and the 1250- and 1425-Å continuum emissions. The data suggest that at early decay times the $^3P_1$ atomic state is responsible for the 1250-Å molecular radiation. From the time-dependent studies it is proposed that the $^1P_1$ state is converted to a highly excited molecule by two-body collisions. This molecule undergoes rapid vibrational relaxation resulting from two- and three-body collisions. The vibrationally relaxed molecule then radiates the 1425-Å continuum. At high pressures (about 1000 torr) the vibrationally relaxed molecule decays with a nearly pressure-independent lifetime of about 0.30 μsec. (auth)

25198 STRUCTURE OF ATOMS FROM THE (e, 2e) REACTION. Hood, S.T.; McCarthy, I.E.; Teubner, P.J.O.; Weigold, E. (School of Physical Sciences, The Flinders University of South Australia, S.A. 5042, Australia). Phys. Rev. A 9: No. 1, 260-266 (Jan 1974).

A model is derived for the differential cross section for (e, 2e) reactions on atoms, leaving the residual ion in an excited state. The eigenstates of the ion are described by the shell model with configuration interaction. In the case of argon, $3s^{-1}$ spectroscopic factors are independently determined. They describe the probability that each of the three ion eigenstates, whose (e, 2e) angular correlation has the $3s^{-1}$ shape, contain the $3s^{-1}$ configuration. Two Hartree-Fock single-particle models are compared. The spectroscopic factors add to 1 for both, but only one correctly predicts the experimental single-hole energy level. (auth)

25199 K-SHELL IONIZATION OF Al, V, Fe, Cu, Y, Mo, Ag, AND Sn BY 1-5-MeV ALPHA-PARTICLE BOMBARDMENT. McKnight, R.H.; Thornton, S.T.; Karlowicz, R.R. (Department of Physics, University of Virginia, Charlottesville, Virginia 22901). Phys. Rev. A 9: No. 1, 267-272 (Jan 1974).

Absolute cross sections have been measured for the K-shell ionization of Al, V, Fe, Cu, Y, Mo, Ag, and Sn by α-particle bombardment over the 1-5-MeV energy range. Characteristic x-ray radiation produced by the ion impact was detected by a cooled Si(Li) detector. Experimental results are compared with ionization cross sections calculated using the plane-wave Born approximation, the semiclassical approach, and the binary-encounter approximation (BEA). The present results agree most favorably with the BEA calculations. Comparisons of cross sections obtained from separate thick- and thin-target measurements show excellent agreement. (auth)

25200 EXPERIMENTAL EVIDENCE FOR NEW DISSOCIATION CHANNELS IN ELECTRON-IMPACT IONIZATION OF H_2. Crowe, A.; McConkey, J. W. (Univ. of Windsor, Ont.). Phys. Rev. Lett.; 31: No. 4, 192-196(23 Jul 1973).

Proton energy spectra were obtained from the dissociative ionization of H_2 by electrons which reveal the existence of many new states lying between the $1s\sigma_g$ ground state of H_2^+ and the $2p\sigma_u$ repulsive state. (auth)

25201 THEORETICAL AND EXPERIMENTAL (ELECTRON-IMPACT) STUDIES OF THE LOW-LYING RYDBERG STATES IN O_2. Cartwright, D. C. (Aerospace Corp., El Segundo, CA); Hunt, W. J.; Williams, W.; Trajmar, S.; Goddard, W. A. III. Phys. Rev., A; 8: No. 5, 2436-2448(Nov 1973).

Theoretical studies of the n = 3, 4, and 5 Rydberg series in O_2, converging to $O_2^+(X\ ^2\Pi_g)$, are presented and correlated with electron energy-loss spectra of molecular oxygen, in the region from 7.0 to 10.5 eV. The energy-loss spectra were studied as a function of the scattering angle for an incident electron energy of 45 eV. The angular dependence determined for various features in the energy-loss spectra were correlated with the known behavior for transitions between electronic states of certain symmetry, and with the theoretical results, to identify the low-lying Rydberg states. Four vibrational levels of the $(3s\ \sigma_g)\ ^3\Pi_g$ Rudberg state were observed superposed on top of the maximum intensity portion of the Schumann–Runge continuum with $T_{00} = 8.145 \pm 0.020$ eV. The theoretical results, combined with the energy-loss measurements and the high resolution photon-absorption work, lead to the assignment of the lowest dipole-allowed $^3\Sigma_u^-$ and $^3\Pi_u$ Rydberg states at $T_{00} \leq$ 9.31 eV and $T_{00} = 9.97$ eV, respectively. (auth)

25202 BEST AB INITIO SURFACE TRANSITION STATE THEORY RATE CONSTANTS FOR THE $D + H_2$ AND $H + D_2$ REACTIONS. Koeppl, G. W. (City Univ. of New York, Flushing). J. Chem. Phys.; 59: No. 6, 3425-3426(15 Sep 1973).

The properties of a previous collinear potential energy surface for the H_3 system and other H_3 surfaces are used to assign values and pessimistic error bounds to those properties required for an absolute reaction rate theory calculation of the rate constants for two isotopic modifications of the $H + H_2$ reaction. The error bounds then allow one to calculate maximum and minimum rate constants which may be compared with experimental values. (JFP)

25203 PARTICIPATION OF INCIDENT ION INTERNAL ENERGY IN MOLECULAR O_2^+–Ar CHARGE-TRANSFER COLLISIONS. Cosby, P. C.; Moran, T. F.; Mornstein, J. V.; Flannery, M. R. (Georgia Inst. of Tech., Atlanta). Chem. Phys. Lett.; 24: No. 3, 431-436(1 Feb 1974).

The O_2^+–Ar charge-transfer reactions were investigated for both the $X^2\Pi_g$ and a $^4\Pi_u$ states of O_2^+ in the kinetic energy range of 0.7 to 3.0 keV. Exhibited resonant and nonresonant behavior of the cross sections is consistent with theoretical predictions. (auth)

25204 LUMINESCENCE OF SILVER UNDER THE INFLUENCE OF ELECTRONS. Artyunyan, F. R.; Mkhitaryan, A. Kh.; Oganesyan, R. A.; Rostomyan, B. O. (Inst. of Physics Research, Erevan). Dokl. Akad. Nauk Arm. SSR; 56: No. 3, 135-139(1973). (In Russian).

The electron-induced luminescence of Ag was studied. The polarization, spectral composition, and angular distribution of the radiation were measured. The dependence of the radiation intensity on the electron energy, beam current, length of irradiation, and angle of flight of the electrons in the target was also determined. (JSR)

25205 FRAME-TRANSFORMED R-MATRIX TREATMENT FOR e^-–CO SCATTERING: A PRELIMINARY REPORT. Chandra, N.; Gianturco, F. A. (Laboratorio di Chimica Quantistica ed Energetica Molecolare, Pisa, Italy). Chem. Phys. Lett.; 24: No. 3, 326-330(1 Feb 1974).

A modified R-matrix approach is proposed to study e^-–molecule collisions for systems with permanent dipole moments. The scattering problem was separately solved in two regions of space by using two different but physically equivalent formalisms in order to properly represent both strong short-range and weak long-range interactions. The R-matrix was defined at the common boundary point to transform the solutions from the inner- to the outer-region frames of reference. (auth)

25206 VIOLATION OF MICROSCOPIC REVERSIBILITY AND THE USE OF REVERSE QUASI-CLASSICAL TRAJECTORIES FOR CALCULATING REACTION CROSS SECTIONS. Bowman, J. M.; Schatz, G. C.; Kuppermann, A. (California Inst. of Tech., Pasadena). Chem. Phys. Lett.; 24: No. 3, 378-380(1 Feb 1974).

In order to calculate the transition probabilities (or cross sections) for reactive collisions, such as $A + BC(v,j) \rightarrow AB(v',j') + C$, using the quasi-classical trajectory method, one quantizes the internal energy of the reagents and in addition adopts some algorithm for calculating the internal quantum numbers of the products. A serious consequence of this procedure is that the quasi-classical results do not obey microscopic reversibility. It is shown that for the collinear $F + H_2(v = 0)$ $FH(v = 2,3) + H$ reaction (and its D_2 counterpart), the quasi-classical trajectory probabilities for the reverse reaction not only differ substantially from the forward ones but in general are in much better agreement with accurate quantum calculations. A similar situation was found for the collinear $H + H_2(0) \rightarrow H_2(1) + H$ reaction. It is suggested that in doing quasi-classical calculations, the reverse of the process of interest should also be considered. Comparison of forward and reverse quasi-classical collinear calculations with accurate collinear quantum results could give an indication of whether forward or reverse calculations should be used for the three-dimensional case. (auth)

25207 DISSOCIATION OF THE $(HeH)^+$ MOLECULAR ION USING ELLIPTIC-TYPE ORBITALS. Mullick, K.; Dastidar, T. K. R.; Barua, A. K. (Indian Association for the Cultivation of Science, Calcutta). J. Phys., B (London); 7: No. 2, 288-296 (1 Feb 1974).

Detailed studies on the electron impact dissociation of the HeH^+ molecular ion produced by the $X^1\Sigma - A^1\Sigma$ transition were made using the Born–Oppenheimer approximation. For these calculations, accurate Harris-type elliptic orbitals for the electronic states of HeH^+ ion were used, which include the effects of distortion polarization due to the heteronuclearity of the ion. The angular distribution of the dissociation fragments and the total dissociation cross section were computed as functions of the incident electron energy. The results obtained show no striking feature due to the heteronuclearity of the molecular ion. Suggestions for further work in this line are given. (auth)

25208 FORMATION OF He^+ (2S) METASTABLE IONS IN PASSAGE OF 10 TO 60 keV $^3He^{2+}$ IONS THROUGH GASES. Shah, M. B.; Gilbody, H. B. (Queen's Univ., Belfast). J. Phys., B (London); 7: No. 2, 256-268(1 Feb 1974).

The formation of $He^+(2S)$ metastable ions by one-electron capture in passage of 10 to 60 keV $^3He^{2+}$ ions through He, Ar, Kr, H_2, N_2 and O_2 was investigated. The fast He^+ (2S) ions were detected by recording the 304 Å radiation emitted during electric field quenching of the metastable state. Studies of the yield of He^+ (2S) ions formed as products of single collisions were used to obtain He^+ (2S) formation cross sections in the different targets with a relative accuracy of ±10%. Absolute cross sections, believed to be accurate to within a factor of two were derived from an approximate calibration of the 304 Å radiation detector. Total cross sections for both one-electron and two-electron capture were also measured and compared with the He^+ (2S) formation cross sections. The growth of He^+ (2S) atoms from $^3He^{2+}$ beams as the target thickness is increased was also investigated in hydrogen, argon and krypton. The maximum fractional yield of He^+ (2S) ions observed was 2.5%. (auth)

25209 COLLISIONS BETWEEN ELECTRONS AND H_2^+ IONS. 5. Measurements of Cross Sections for Dissociative Recombination. Peart, B.; Dolder, K. T. (Univ. of Newcastle upon Tyne, Eng.). J. Phys., B (London); 7: No. 2, 236-243(1 Feb 1974).

Inclined beams of electrons and H_2^+ ions were used in measurements of dissociative recombination cross sections of H_2^+ for interaction energies between 0.33 and 4 eV. It was estimated that the absolute accuracy of the results was about ±10%, and the energy resolution ranged from 0.15 to 0.30 eV. The ions are believed to have had the initial distribution of vibrational states measured by von Busch and Dunn (Phys. Rev. A; 5: 1726-43(1972)). The cross section fell from 2.2×10^{-15} cms^2 at 0.33 eV to 1.9×10^{-16} cm^2 at 4 eV. (auth)

25210 PERTURBATION THEORIES FOR THE CALCULATION OF MOLECULAR INTERACTION ENERGIES. I. General Formalism. Chipman, D. M.; Bowman, J. D.; Hirschfelder, J. O. (Univ. of Wisconsin, Madison). J. Chem. Phys.; 59: No. 6, 2830-2837(15 Sep 1973).

In the calculation of the interaction energy of two atoms, it is particularly convenient to take the zero order Hamiltonian $H^{(0)}$ to be the sum of the atomic Hamiltonians. Then $H^{(0)}$ does not reflect the full permutational symmetry of the exact Hamiltonian H. Many different perturbation expansions with such a "nonsymmetric" H^0 have been proposed. These expansions are reviewed and classified within a very general perturbation framework. Also, a new "optimized" method is proposed which, by virtue of the Rayleigh–Ritz variational principle, is guaranteed to give better results than any of the previously suggested methods. For simplicity the analysis is restricted to the case that the spin-free zero order function $\phi^{(0)}$ and the spin-free exact wave function Ψ are both nondegenerate. As an example, the construction of the first order wave function in each method is discussed in detail for the simple case of a single symmetry operation. (auth)

25211 FEATURES OF EXCITATION OF AUTOIONIZATION STATES OF Ne ATOMS IN SLOW COLLISIONS WITH Na^+ IONS. Bydin, Yu. F.; Vol'pyas, V. A.; Ogurtsov, V. I. (Leningrad Electrotechnical Inst.). JETP Lett. (USSR) (Engl. Transl.); 18: No. 9, 322-324(5 Nov 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 9, 547-549(5 Nov 1973).

The excitation of discrete groups of fast electrons by collision of Na^+ ions with Ne atoms was investigated at the relative-motion energies W from 80 to 320 eV. Resonant excitation of the autoionization states of neon was observed at W near 150 eV. (auth)

Atomic Theory

Refer also to abstracts 25655 and 25933.

25212 (ANL-8060(Pt. 1), pp 102-118) COMPILATION OF ATOMIC PARAMETERS BASED ON HARTREE–SLATER CALCULATIONS FOR ATOMS OF THE FIRST TWO ROWS. Dehmer, J. L.; Saxon, R. P. 1973.

In Radiological and Environmental Research Division annual report: radiation physics, July 1972–June 1973.

Asymptotic phase shifts, quantum defects, and oscillator-strength distributions and their moments—all based on the Hartree–Slater model—are tabulated for the atoms of the first two rows. (7 tables) (auth)

25213 (JINR-P4-7568) CORIOLIS INTERACTION IN ADIABATIC REPRESENTATION OF THREE-BODY PROBLEM. Vinitskii, S. I.; Ponomarev, L. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 28p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

For the three-body problem with the Coulomb interaction (two nuclei and an electron) in the adiabatic basis there was obtained a one-dimensional system of differential equations that represents relative motion of nuclei taking into account the Coriolis interaction of the electron and nuclear motion. The obtained equations are convenient for numerical calculations. The effective potentials of the system are presented as integrals in spherical, spheroidal and parabolic coordinates. (auth)

25214 ATOMIC L-SHELL COMPTON PROFILES AND INCOHERENT SCATTERING FACTORS: THEORY. Bloch, B.J.; Mendelsohn, L.B. (Polytechnic Institute of Brooklyn, Brooklyn, New York 11201). Phys. Rev. A 9: No. 1, 129-155 (Jan 1974).

Compton profiles are calculated for L-shell electrons within the Born approximation by use of nonrelativistic "exact" hydrogenic bound- and continuum-state wave functions. The wave functions are expressed in parabolic coordinates and the resulting matrix elements are evaluated following the method of F. Bloch (1934). Impulse-approximation profiles are calculated, and comparisons with the "exact" profiles show that, as expected, the two profiles lie very close to one another for weak binding and high incident photon energies. However, even when these conditions are not fulfilled, the two curves have a tendency to cross one another in the neighborhood of the profile center. This tendency has been observed in previous studies of K-shell profiles. However, unlike K-shell profiles, the 2S Compton profiles exhibit a secondary maximum. The secondary maxima occur at approximately the same region in q, where the impulse-approximation profiles exhibit a plateau. The location of this plateau is shown to be related to a node in the bound-state wave function and is around $q = Z/2$ for the 2S profiles. The impulse approximation, being a monotonic decreasing function in $|q|$, cannot exhibit the secondary-maximum structure appearing in the "exact" hydrogenic profiles. The intensity of the secondary maximum in the 2S profiles is reduced by over an order of magnitude from the central peak. The $2P^{(0)}$ Compton profiles also exhibit structure, however, unlike the relatively small secondary maximum in the 2S, the two maxima in the $2P^{(0)}$ profiles are of the same order of magnitude. Integrated profiles (incoherent-scattering factors) are calculated and the impulse-approximation results agree with the "exact" results over a wide range of binding energies owing to profile crossover near the center. Waller–Hartree incoherent-scattering factors give a closer agreement with the "exact" results than observed for K-shell electrons; however, for low-momentum transfer the Waller–Hartree results can differ from "exact" results by more than 50%. In such regions, impulse-scattering factors represent a considerable improvement over the Waller–Hartree factors. (auth)

25215 EXCITED STATE COUPLING IN LOW ORDER MANY-BODY THEORY. Yaris, R. (Washington Univ., St. Louis). Chem. Phys. Lett.; 24: No. 3, 386-388(1 Feb 1974).

By using a matrix analog to the standard summation of diagonal ladder diagrams, it is shown that one can sum an infinite class of diagrams and obtain excited state coupling in low-order diagrams. (auth)

25216 GROUND-STATE IONIZATION FOR IONIZED ATOMS BY THE THOMAS–FERMI MODEL. Wittwer, L. A.; Bloom, S. D. (Univ. of California, Livermore). Phys. Rev., A; 8: No. 5, 2249-2254(Nov 1973).

A calculation was made of the ionization potentials for atoms of arbitrary Z and arbitrary degree of ionization using the Thomas–Fermi model. A modified approach is used to numerically evaluate the binding and ionization energies which depends on an integration scheme that starts at the atomic radius and proceeds inward to the origin. Since exchange energy is not included, the results are not reliable for $\gamma < 0.1$, where γ is the fractional deviation of the ion from neutrality. Also the results cannot be used when the ion has only a few electrons left since then the statistical assumption breaks down. (auth)

25217 COLLECTIVE OSCILLATIONS IN MANY ELECTRON ATOMS. I. Eigenvalues and Polarization. Monaghan, J. J. (Univ. of Colorado, Boulder). Aust. J. Phys.; 26: No. 5, 597-606(Oct 1973).

Following the work of Bloch, the Thomas–Fermi model is extended to collective oscillations. The eigenfunctions and frequencies for radial and nonradial $l = 1$ modes are found. The calculated static polarization is compared with experiment, both for ions and neutral atoms, and the classical oscillator strengths are computed. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

25218 CHARACTERISTICS OF A PLANE ELECTROHYDRODYNAMIC WALL JET. Amasovich, Yu. I. (Kiev Inst. of Civil Aviation Engineers). Fluid Mech. - Sov. Res.; 2: No. 6, 117-120(1973).

The problem of propagation of a plane laminar electrohydrodynamic wall jet above a conducting plate is examined in the one-dimensional approximation. The electrohydrodynamic boundary layer is assumed to have a finite thickness. The problem is solved by the Shvets method, suggested for solving equations of the hydrodynamic boundary layer. The final solution is found by computer by the numerical Runge–Kutta method. (auth)

25219 DEVELOPMENT OF AN MHD-AUGMENTED, HIGH ENTHALPY, SHOCK TUNNEL FACILITY. Pate, S. R.; Siler, L. G.; Stallings, D. W.; Wagner, D. A. (ARO, Inc., Arnold Air Force Station, TN). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 12: No. 3, 289-297(Mar 1974).

Experimental and theoretical studies conducted in support of the development of a high performance, hypersonic/hypervelocity shock tunnel facility (AEDC-VKF Tunnel J) capable of providing thermochemical equilibrium and nonequilibrium flow conditions at high enthalpies are presented. Demonstrated capabilities of the facility with and without magnetohydrodynamic (MHD) flow augmentation are shown. Increases in the flow velocity from 12,000 to 21,000 fps were obtained using an MHD nozzle accelerator with the flow seeded with potassium carbonate. Good agreement is shown to exist between one-dimensional MHD theory and experimental data for two calibrated conditions. Calibration and analysis of the flow in the MHD accelerator channel and in a two-stage nozzle system, with and without MHD augmentation, are included. It is shown that quantitative aerodynamic measurements can be obtained in an MHD-augmented shock tunnel facility. A full-scale, impulse-heated, high performance driver ($p_4 = 44,000$ psi, $T_4 = 800°K$) using helium and nitrogen was developed (concurrently but not in conjunction with the MHD shock tunnel) and experimental shock tube data are presented. Projected capabilities of the facility using the high performance driver are included. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

25220 (COO-2232-22(Ex.)) EXPERIMENTAL STUDIES OF ELEMENTARY PARTICLE INTERACTIONS AT HIGH ENERGIES. Technical Progress Report. (Rockefeller Univ., New York (USA)). Jan 1974. 18p. Dep. NTIS $3.00.

Experimental research on high energy physics is summarized. (JFP)

Electromagnetic

Refer also to abstract 24334.

25221 (COO-3065-70) MUON BREMSSTRAHLUNG. Koenigsmann, K. C. (Rochester Univ., N. Y. (USA). Dept. of Physics and Astronomy). 1973. Contract AT(11-1)-3065. 106p. (UR-471). Dep. NTIS $7.50.

Thesis.

An experiment is described which measures muon bremsstrahlung using a muon beam at the Brookhaven National Laboratory AGS for 4-momentum transfers up to 1.7 GeV/c. The aim of the experiment was a test for fractionally charged partons in the scaling region. Incident muons of momentum 7.2 GeV/c were obtained at the AGS with a flux of $\sim 10^6$ per 10^{12} protons and a pion contamination of $<10^{-6}$. The beam was incident on a beryllium target 8 inches long and 6 × 8 inches wide. The scattered muon spectrometer was set at an averaged angle of 16°, and the photon detectors covered a range from 9 to 41°. Positive and negative beam polarities were used to determine the interference of the Bethe-Heitler graph with the virtual Compton scattering graph. Comparison is made to the Bethe-Heitler prediction and the prediction based on the parton model as calculated by Brodsky, Gunion, and Jaffe. The results are presented as a function of the invariant 4-momentum transfer squared, Q_B^2 and the energy-loss ν_B. The data are in the region of $0.5\ (\mathrm{GeV/C})^2 \le Q_B^2 \le 2(\mathrm{GeV/c})^2$ and $0.0\ \mathrm{GeV} \le \nu_B \le 5.0$ GeV, where the measured cross section is much larger than expected from the parton model prediction for integrally charged partons. Furthermore, the proton structure function V(x) is presented which shows a peak at $x \approx 1/3$, where x is the Bjorken's scaling variable. The main contribution to the photon events stems from the virtual Compton amplitude. This implies a two photon exchange in the inclusive muon data, giving rise to an asymmetry which is indeed observed. (auth)

25222 (DESY-73-49) INCLUSIVE REACTIONS INDUCED BY. ELECTROMAGNETIC CURRENTS: PARTICLE PRODUCTION. Brasse, F. W. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Oct 1973. 76p. (CONF-730842-6). Dep. NTIS (U. S. Sales Only) $6.00.

From international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973).

Research on inclusive photo- and electroproduction experiments carried out at many laboratories is reviewed. The studies include structure functions, Feynman scaling, limiting fragmentation, multiplicities, cross sections, and distributions. (JFP)

25223 (DESY-73-50) THRESHOLD ELECTROPRODUCTION EXPERIMENTS AND THE AXIAL VECTOR FORM FACTOR. Read, B. J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Oct 1973. 29p. (CONF-730842-7). Dep. NTIS (U. S. Sales Only) $3.50.

From international symposium on electron and photon interactions at high energies; Bonn, F. R. Germany (27 Aug 1973).

Data from three coincidence experiments which measure the cross section for π^+ electroproduction around threshold are compared. Application of the PCAC motivated pseudovector Born approximation model yields corresponding values of the nucleon axial vector form factor for spacelike momentum transfer up to 0.6 GeV^2. Attention is paid to possible theoretical uncertainties and to the influence of the first pion–nucleon resonance. (Recent single arm SLAC results are also included.) (auth)

25224 (ORO-3956-6) BUBBLE CHAMBER STUDIES OF HADRON AND PHOTON INTERACTIONS. Progress Report, June 1, 1973–May 31, 1974. Bugg, W. M.; Condo, G. T.; Hart, E. L. (Tennessee Univ., Knoxville (USA)). 1974. Contract AT(40-1)-3956. 6p. Dep. NTIS $3.00.

Research on bubble chamber studies of hadron and photon interactions is summarized. A list of publications is appended. (JFP)

25225 TOTAL AND PARTIAL γd, γn, AND γp CROSS SECTIONS AT 7.5 GeV. Alexander, G.; Gandsman, J.; Jacobs, L. D.; Levy, A.; Lissauer, D.; Rosenstein, L. M. (Tel-Aviv Univ., Israel). Nucl. Phys., B; 68: No. 1, 1-11(1974).

Total and partial γd, γp and γn reactions were studied in the SLAC 82 inch deuterium-filled bubble chamber, which was exposed to a linearly polarized photon beam at an energy of 7.5 GeV. Total, topological and channel cross sections for these reactions are reported. The γn average charge multiplicity was found to be one unit of charge less than the γp average charge multiplicity. The isoscalar-isovector interference term as calculated by comparing the γp charge symmetric reactions is found to be small. (auth)

25226 SEARCH FOR HEAVY LEPTONS WITH e^+e^- COLLIDING BEAMS. Orito, S. (CNEN, Frascati, Italy); Visentin, R.; Ceradini, F.; Conversi, M.; d'Angelo, S.; Paoluzi, L.; Santonico, R. Phys. Lett.; 48B: No. 2, 165-168(21 Jan 1974).

A search for heavy leptons was carried out with the Frascati e^+e^- storage ring by looking for (μe) pairs. A lower mass limit of 1.15 GeV, with 95% confidence level, is obtained for various types of heavy leptons. (auth)

25227 $K_S^0K_L^0$ PRODUCTION BY e^+e^- ANNIHILATION AT PHI ENERGY. Cosme, G.; Jean-Marie, B.; Jullian, S.; Laplanche, F.; Lefrancois, J.; Parrour, G. (Univ. Paris-Sud, Orsay, France). Phys. Lett.; 48B: No. 2, 159-161(21 Jan 1974).

Data were taken at the ϕ energy with the same large solid angle detector which has been used for the measurement of the ρ and ω production by e^+e^- annihilations. From the $\phi \to K_L^0 K^0_{S\,\pi^+\pi^-}$ excitation curve the ϕ width $\Gamma_\phi = (3.81 \pm 0.37)$ MeV and the cross section $\sigma_{e^+e^- \to K_S^0K_L^0} = (1.48 \pm 0.08 \pm 0.12)\mu b$ were deduced. (The quoted errors are respectively statistical and systematical). (auth)

25228 $\pi^+\pi^-\pi^0$ AND $\pi\pi\gamma$ PRODUCTION BY e^+e^- ANNIHILATION IN THE PHI ENERGY RANGE WITH THE ORSAY STORAGE RING. Cosme, G.; Jean-Marie, B.; Jullian, S.; Laplanche, F.; Lefrancois, J.; Liberman, A. D.; Parrour, G.; Repellin, J. P.; Sauvage, G. (Univ. Paris-Sud, Orsay, France). Phys. Lett.; 48B: No. 2, 155-158(21 Jan 1974).

A large solid angle detector was used to observe $\pi^+\pi^-\pi^0$ events produced at the ϕ energy by electron-positron collisions in the Orsay storage ring. Fitting the data with a Breit and Wigner curve, with a fixed width $\Gamma = (3.8 \pm 0.4)$ MeV coming from $K_S^0K_L^0$ analysis, $\sigma_{e^+e^- \to \pi^+\pi^-\pi^0} = (0.70 \pm 0.13)\ \mu b$ at $2E = M_\phi$ is deduced. Using the measurements on the other ϕ decay modes $(\phi \to \pi^+\pi^-\pi^0)/(\phi \to K_S^0K_L^0) = 0.47 \pm 0.06$ and $(\phi \to \eta^0\gamma)/(\phi \to K_S^0K_L^0) = 0.077 \pm 0.022$ are deduced. Assuming $(\phi \to K^+K^-)/(\phi \to K_S^0K_L^0) = 1.60$, $\sigma_{TOT} = (4.7 \pm 0.4)\ \mu b$, $\Gamma_{e^+e^-} = (1.27 \pm 0.11$ keV and $g_\phi^2/4\pi = 14.3 \pm 1.3$ (without finite width correction) are derived. Furthermore (from the observation of the $\pi\pi\gamma$ coplanar events) an upper limit is given to the mode $e^+e^- \to \phi \to \pi^+\pi^-\gamma$, $\Gamma(\phi \to \pi^+\pi^-\gamma) \le 0.007\,\Gamma(\phi \to \mathrm{Total})$ with 90% C.L. (auth)

25229 ISOTENSOR ELECTROMAGNETIC CURRENT AND THE $\pi^\pm$ PHOTOPRODUCTION DATA IN THE $\Delta(1236)$ RESONANCE REGION. Aznauryan, I. G.; Nagorskaya, I. A. (Erevan Inst. of Physics). Yadern. Fiz.; 19: No. 1, 136-143(Jan 1974). (In Russian).

The dispersion relations at fixed momentum transfer with high-energy contributions are used to analyze the $\pi^\pm$ photoproduction in the $\Delta(1236)$-resonance region. It is shown that the data on the $\gamma p \to n\pi^+$ and $\gamma n \to p\pi^-$-differential cross sections are sufficient to estimate the isotensor electromagnetic current. Such estimation is made for the available data on $\gamma p \to n\pi^+$ and $\gamma n \to p\pi^-$. The method under consideration is also applied to the polarization data. (auth)

25230 PRODUCTION OF PION AND MUON PAIRS IN COLLIDING e^+e^--BEAMS. Outside the Equivalent Photon Approach. Serbo, V. G.; Chernyak, V. L. (Inst. of Mathematics, Moscow). Yadern. Fiz.; 19: No. 1, 127-135(Jan 1974). (In Russian).

Reactions $e^+e^- \to e^+e^-\pi^+\pi^-(\mu^+\mu^-)$ are considered in the situation when only pions (muons) are detected, while the total transverse momentum of the pair is not too small (roughly speaking, $m_e^2 \ll k_\perp^2 \ll m_\pi^2$; the contribution from this region is dominating in the cross section). The differential cross sections are obtained with accuracy $\sim (k_\perp/m_\pi)\ (\ln k_\perp^2/m_e^2)^{-1}$; the charge asymmetry of the pions (muons) is calculated. It is shown, which information on the amplitude of the reaction $\gamma\gamma \to \pi^+\pi^-$ and on the pion electromagnetic form factor may be obtained from experimental study of these reactions under the given conditions. (auth)

25231 MEASUREMENT OF THE CHARGE ASYMMETRY IN THE DECAY $\eta \to \pi^+\pi^-\gamma$. Jane, M. R. (Rutherford Lab., Chilton, Eng.); Jones, B. D.; Lipman, N. H.; Owen, D. P.; Penny, B. K. Phys. Lett.; 48B: No. 3, 265-268(4 Feb 1974).

An experiment to look for a possible asymmetry in the decay $\eta \rightarrow \pi^+\pi^-\gamma$ is reported. The asymmetry for 34,680 η decays was measured to be 0.012 ± 0.006, which is consistent with no C violation in this decay mode. (auth)

25232 MEASUREMENT OF THE CHARGE ASYMMETRY IN THE DECAY $\eta \rightarrow \pi^+\pi^-\pi^0$. Jane, M. R. (Rutherford Lab., Chilton, Eng.); Jones, B. D.; Lipman, N. H.; Owen, D. P.; Penny, B. K. Phys. Lett.; 48B: No. 3, 260-264(4 Feb 1974).

An experiment to look for a possible asymmetry in the eta decay to three pions is reported. Eta mesons were produced in the process $\pi^-p \rightarrow \eta n$. The experiment produced 165311 decays $\eta \rightarrow \pi^+\pi^-\pi^0$, from which was determined a value for the charge asymmetry, A = (0.0028 ± 0.0026). No evidence for C violation in this decay was seen. (auth)

Weak

25233 ABSOLUTE VALUE $\Delta I = \frac{1}{2}$ RULE IN NON-LEPTONIC WEAK INTERACTIONS WITH HAN–NAMBU QUARKS. Fayet, P. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Phys. Lett.; 48B: No. 2, 145-147(21 Jan 1974).

Gauge theories of weak and electromagnetic interactions involving Han–Nambu quarks are constructed with the following features: small $K_L \rightarrow \mu\bar{\mu}$ amplitude and $K_L - K_S$ mass splitting; a non-leptonic effective Lagrangian $\Delta Y = \pm 1$ leading to the usual soft-pion theorems and obeying a fundamental $|\Delta I| = \frac{1}{2}$ rule, with corrections of order $\theta^2_{\mathrm{Cabibbo}}$. (auth)

25234 $K^0_L - K^0_S$ REGENERATION ON DEUTERIUM. Berlin–Budapest–Dubna–Prague–Serpukhov–Sofia Collaboration. Phys. Lett.; 48B: No. 3, 257-259(4 Feb 1974).

The $K^0_L - K^0_S$ regeneration on deuterium was measured at the 70-GeV Serpukhov accelerator in a momentum region of 18–50 GeV/c. The measurements were performed by means of a 3 m long liquid deuterium target and an on-line spectrometer. The preliminary results on the energy dependence of the modulus and phase of the transmission regeneration amplitude are reported. (auth)

Strong (Baryon-induced)

Refer also to abstract 25636.

25235 (BNL-18598) HIGH TRANSVERSE MOMENTUM AT ISABELLE. Lederman, L. M. (Brookhaven National Lab., Upton, N.Y. (USA)). Feb 1974. 10p. Dep. NTIS $3.00.

The present data on high P_T hadronic phenomena are summarized. Inclusive pion production, quantum numbers, and jet structure are included. (JFP)

25236 (CEA-CONF-2454) ELASTIC AND INELASTIC SCATTERING OF 1 GeV PROTONS. Thirion, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). [nd]. 28p. (CONF-730642-15). Dep. NTIS (U. S. Sales Only) $3.50.

From 5th international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

Proton reactions with carbon-12, oxygen-16, lithium-6, nickel-58, and lead-208 are discussed. The angular distributions for elastic and inelastic scattering are given. Structures including the giant resonance are shown in the carbon-12 spectra, and levels in carbon-11 are clearly resolved. The differential cross sections are plotted for these reactions. (JFP)

25237 (COO-3065-57) DIFFRACTIVE COMPONENT IN PP COLLISIONS AT 102 AND 405 GeV. Chapman, J. W.; Cooper, J. W.; Green, N.; Seidl, A. A.; Vander Velde, J. C.; Bromberg, C. M.; Cohen, D.; Ferbel, T.; Slattery, P. (Michigan Univ., Ann Arbor (USA); Rochester Univ., N.Y. (USA)). 1973. 15p. (UR-458). Dep. NTIS $3.00.

We study the diffractive component in pp collisions at 102 and 405 GeV and examine its energy dependence in M^2 and X variables. The total cross section for $|X| > .9$ remains approximately constant: (6.6 ± .5) mb and (6.8 ± .7) mb at the two energies. However, both $d\sigma/dX$ and $d\sigma/dM^2$ show strong energy dependence within the $|X| > .9$ region. The energy and M^2 dependences of $d\sigma/dM^2$ do not have the characteristics of a triple pomeron term for $.90 < |X| < .99$. (auth)

25238 (JINR-E1-7559) MEASUREMENT OF THE ASYMMETRY OF QUASI-ELASTIC SCATTERING OF POLARIZED 635 ± 12 MeV PROTONS BY ^{6}Li NUCLEI. Nadezhdin, V. S.; Petrov, N. I.; Satarov, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

The asymmetry of quasi-elastic scattering of polarized 635 ± 12-MeV protons scattered by ^{6}Li nuclei was measured for the nonsymmetric complanar geometry corresponding to the scattering angle $\theta = 57°$ (c.m.s.) of the incident and nuclear nucleons. With residual nuclear nonzero momenta the measured values of the asymmetry of quasi-elastic scattering differ from that of the free pp scattering asymmetry. (auth)

25239 (LUIP-CR-73-15) NUCLEAR INTERACTIONS OF 200 GeV PROTONS IN EMULSION. Barcelona-Batavia-Belgrade-Bucharest-Lund-Lyons-Montreal-Nancy-Ottawa-Paris-Rome-Strasbourg-Valencia Collaboration. (Lund Univ. (Sweden). Fysiska Institutionen). Dec 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

Proton-nucleus interactions were studied in nuclear emulsion exposed to the NAL 200 GeV proton beam. The inelastic mean free path is found to be 35.5 ± 0.8 cm, and the average shower particle multiplicity is 12.9 ± 0.2. The angular distribution reveals some characteristic features of proton-nucleus interactions. (auth)

25240 REACTION $pd \rightarrow pd\pi^+\pi^-$ AT 11.6 GeV/c. Hochman, D.; Eisenberg, Y.; Karshon, U.; Shapira, A.; Ronat, E. E.; Yaffe, D.; Yekutieli, G. (Weizmann Inst., Rehovot, Israel). Nucl. Phys., B68: No. 2, 301-311(1974).

The coherent reaction $pd \rightarrow pd\pi^+\pi^-$ is studied in pd collisions at 11.6 GeV/c. Strong Δ^{++} (1236) production together with some $d\pi^-$ enhancement (d^{0*}) at ~2200 MeV are found in this reaction. The mass spectrum of the pure $I = \frac{1}{2}$ combination $p\pi^+\pi^-$ shows a significant peak at ~1460 MeV. A double Regge fit describes the general feature of the $M(p\pi^+\pi^-)$ distribution, but does not reproduce the narrow peak. Comparison with a similar analysis at 7.0 GeV/c shows the same results, however the d^{0*} cross section decreases with incident energy. (auth)

25241 INELASTIC DIFFERENTIAL CROSS SECTION IN IMPACT PARAMETER SPACE AT ISR ENERGIES. Henzi, R.; Valin, P. (McGill Univ., Montreal). Phys. Lett.; 48B: No. 2, 119-124 (21 Jan 1974).

Implications of increasing total cross sections and diffractive structures at CERN-ISR on the inelastic differential cross section in impact parameter space are discussed. It is a Gaussian plus a small "edge" correction and its increase through the ISR energies is peripheral as compared to the overall region of inelastic collisions, while inside this region it remains relatively constant and below the unitarity bound. (auth)

25242 ANTIPROTON CHARGE-EXCHANGE ON PROTONS AT 25 AND 35 GeV/c. Bolotov, V. N.; Isakov, V. V.; Kakauridze, D. B.; Kachanov, V. A.; Postoev, V. E.; Prokoshkin, Yu. D. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 19: No. 1, 115-120(Jan 1974). (In Russian).

The cross sections of the $pp \rightarrow nn$ reaction are measured at 25 and 35 GeV/c momenta. The cross sections decrease as $\sim 1/p^2$ when the momentum increases. The differential cross section shows a narrow peak at momentum transfer $0 \lesssim -t \lesssim 0.02$ $(\mathrm{GeV}/c)^2$. The ρ and A_2 exchanges are not essential in the region which was investigated. (auth)

25243 COMPARISON OF THE REACTIONS $\pi^-p \rightarrow p + X$ and $pp \rightarrow p + X$ AT 205 GeV/c. Winkelmann, F. C. (Univ. of California, Berkeley). Phys. Lett.; 48B: No. 3, 273-276(4 Feb 1974).

Characteristics of the reactions $\pi^-p \rightarrow p + X$ and $pp \rightarrow p + X$ are compared at 205 GeV/c. In the lower-multiplicity final states significant differences are observed in the spectrum of M^2, the mass-squared of the produced system X. However, the inclusive reactions show remarkable similarities in the distribution of momentum transfer to the recoil proton and in the dependence on M^2 of the average charged multiplicity of X. Triple-Regge theory with PPP or PRR terms is found to predict the ratio of the inclusive cross sections correctly for $30 \lesssim M^2 \lesssim 120$ GeV^2. (auth)

Strong (Meson-induced)

Refer also to abstract 24330.

25244 (ANL/HEP-7364) MEASUREMENT OF THE DIFFERENTIAL CROSS SECTION AT 3, 4, 5, 6 GeV/c FOR THE REACTIONS $\pi^-p \rightarrow K^0\Lambda^0$ AND $\pi^-p \rightarrow K^0\Sigma^0$ AND OF Λ^0 POLARIZATION AT 5 GeV/c. Lesnik, A. (Chicago Univ., Ill. (USA)). Dec 1973. 161p. Dep. NTIS $10.25.

Thesis. Submitted to Chicago Univ., Ill. Dept. of Physics.

The differential cross section in the reaction $\pi^-p \rightarrow K^0\Lambda^0$, $\pi^-p \rightarrow K^0\Sigma^0$ was measured at incident beam momenta of 3, 4, 5, and 6 GeV/c and at momentum transfers to $t \sim -2.0$. The polarization of Λ^0 was also measured at 5 GeV/c using the parity violating decay $\Lambda^0 \to p\pi^-$. Wire spark chambers with magnetostrictive readout, scintillators, and Cerenkov counters were used and most of the calculations were performed on-line with an EMR-6050 computer. Due to the experimental method the results have much smaller error than previous bubble chamber measurements. (auth)

25245 (COO-3066-36) π–π PHASE SHIFTS IN THE ENERGY REGION 0.6 TO 1.42 GeV. Toaff, S.; Anderson, J. C.; Engler, A.; Kraemer, R. W.; Weisser, F.; Diaz, J.; DiBianca, F. A.; Fickinger, W.; Robinson, D. K.; Sullivan, C. A. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA); Case Western Reserve Univ., Cleveland, Ohio (USA)). 1972. 5p. Dep. NTIS $3.00.

Results are presented on π-π scattering via the reaction $\pi^+n \to \pi^+\pi^-p$ at 6 GeV/c. Using a one-pion exchange model modified by absorption and $I = 2$ phase shifts from other experiments S, P, and D wave π-π phase shifts were extracted under certain energy dependent assumptions. The data sample consists of approximately 13,000 events in the energy region 0.6 to 1.42 GeV. (auth)

25246 (DESY-73-46) SEPARATION OF CLUSTERS IN THE REACTION $\pi^+p \to \pi^+\pi^+\pi^-p$ AT 11.7 GeV/c. Bassler, E.; Nagel, H.; Schlatter, W. D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Oct 1973. 22p. (CONF-730976-2). Dep. NTIS (U. S. Sales Only) $3.25.

From 4th international symposium on multiparticle hadrodynamics; Pavia, Italy (Sep 1973).

A Monte-Carlo selection method is presented in the full 3N-5 dimensional kinematic space and applied to the reaction $\pi^+p \to \pi^\pm p\pi^+\pi^-$ at 11.7 GeV/c. The method is tested by comparing the results with those from maximum likelihood fits and by applying it to a simulated experiment. The quasi two body reactions could be separated and their cross sections correctly determined. The method is shown to reproduce the differential distributions, at least of the more important reactions, without bias. (auth)

25247 (IFA-HE-82) NEUTRAL STRANGE PARTICLE PRODUCTION IN π^-p, π^-n, and π^-c INTERACTIONS AT 40 GeV/c. Bucharest–Budapest–Krakow–Dubna–Hanoi–Sofia–Taskent–Tbilisi–Ulhan–Bator Collaboration. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 28p. Dep. NTIS (U. S. Sales Only) $3.50.

Results are reported on the inclusive cross sections for Λ (Σ°) hyperons and K° mesons produced in π^-p, π^-n and π^-c interactions at 40 GeV/c in propane bubble chamber as well as the cross sections for producing events of the type Λ K° and $K\bar{K}$. Results on the cross section measurements for the various topologies will be presented too. It is found that $\sigma^{\pi^-p}_{\Lambda(\Sigma^-)}$ has increased twofold from 25 to 40 GeV/c. The cross section for $K\bar{K}$ production is still growing with increasing incident energy. The average numbers for K° mesons and Λ hyperons per π^-p interaction are $\langle n_K \rangle = 0.24 \pm 0.03$ and $\langle n_\Lambda \rangle = 0.07 \pm 0.01$ respectively. The invariant single-particle distributions in Feynman variable x for the inclusive K_1^0 and Λ reactions are presented and compared with those for π^-p interactions at lower energies and pp interactions at 205 GeV as well. (auth)

25248 (JEN-277) STUDY OF π^+p INTERACTIONS AT 1.2 GeV/c. Ladron de Guevara, P. (Junta de Energia Nuclear, Madrid (Spain)). 1973. 210p. (In Spanish). Dep. NTIS (U. S. Sales Only) $12.50.

The main results of a 0.33 events/μbarn experiment of π^+ interactions in hydrogen at 1.2 GeV/c, using the 80 cm Saclay bubble chamber. The partial cross sections of the different reactions and the elastic differential cross section are computed by normalizing to the total cross section obtained by other groups. The production of the Δ (1236), η^0(549), ρ (760) and N ^{1}s in the 1.500 GeV region are studied in the inelastic channels, as well as the decay properties of the Δ (1236) produced in the $\pi^+p\,\pi^0$ final state. (auth)

25249 (JINR-P1-7566) MAGNETIC SPECTROMETER WITH HELIUM STREAMER CHAMBER FOR MEASUREMENT OF PION SCATTERING AT 180°. Balestra, F.; Barbini, R.; Busso, L.; Garfagnini, R.; Guaraldo, K.; Kulyukin, M. M.; Piragino, G.; Scrimaglio, R.; Falomkin, I. V.; Shcherbakov, Yu. A. (Joint Inst. for Nuclar Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Experimental equipment for studying pion scattering on nuclei at large angles is described. The equipment was used in the pion beam experiments at the National Laboratory of Frascati, Italy. The magnetic spectrometer consists of a streamer chamber (filled with helium at atm. pressure) intended for identification of scattering events. The required localization and sufficient brightness of tracks is achieved without using the "blumline" system. The accuracy of particle momentum measurement obtained with the spectrometer is compared with the estimate performed by the Monte Carlo method. (auth)

25250 (JINR-P1-7668) STUDY OF THE INCLUSIVE REACTIONS INVOLVING γ-QUANTA IN π^-p, π^-C^{12} INTERACTIONS AT $p = 40$ GeV/c. Abdurakhimov, A. U.; Angelov, N.; Vishnevskaya, K. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Some results are presented on the study of the inclusive spectra of γ-quanta and π^0-mesons in π^-p, π^-C^{12}-interactions at 40 GeV/c. It is shown that in the reaction $\pi^-p \to \gamma + \ldots$ the factorization of the structure function $f(q_\perp, x)$ over variables $q_\perp$ and x is not observed in the ranges $q_\perp \leq 0.4$ GeV/c and $I \times I \leq 0.16$. By the statistical regularization method, the spectrum of the longitudinal momenta of π^0-mesons in the c.i.s. is determined according to the measured γ quantum spectra. It is determined that, in the range of $-0.02 \leq x \leq 0.02$, $N_{\pi^+} \simeq N_{\pi^-} \simeq N_{\pi^0}$, within the error (±7%). The comparison of the inclusive γ quantum spectra in π^-p and π^-C^{12} interactions shows that the normalized structure functions are the same for both the reactions in the central region and in the region of π-meson fragmentation. (auth)

25251 (JINR-P1-7680) STUDY OF π^-N COLLISIONS OF HIGH MULTIPLICITY ($n_\pm \geq 5$) at $P = 40$ GeV/c. Abdurakhimov, A. U.; Angelov, N.; Grishin, V. G.; Ivanovskaya, I. A.; Kanarek, T.; Kladnitskaya, E. N.; Lyubimov, V. B.; Mel'nikova, N. N.; Smirnova, L. N.; Solov'ev, M. I.; Supichakov, Kh. Ya.; Tevzadze, Yu. P.; Fadeev, N. G.; Shcheglova, L. M.; Yancho, G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 44p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.25.

The momentum and angular distributions for the secondary charged mesons, the inelasticity coefficient value as well as the longitudinal and transverse momentum distributions of $\pi^\pm$-mesons produced in the reactions $\pi^-N \to N + n\pi^\pm$ ($n_\pm = 5, 6, \ldots, 12$) at $Pc = 40$ GeV/c are presented. Experimental results are compared with the statistical theory predictions. (auth)

25252 (LBL-2114) MEASUREMENT OF THE POLARIZATION PARAMETER FOR THE REACTION $\pi^-p \to \pi^0n$ BETWEEN 1.03 AND 1.79 GeV/c. Shannon, S. R.; Anderson, L.; Bridgewater, A.; Chaffee, R.; Chamberlain, O.; Dahl, O.; Fuzesy, R.; Gorn, W.; Jaros, J.; Johnson, R.; Kenney, R.; Nelson, J.; O'Keefe, G.; Oliver, W.; Papp, J.; Pollard, D.; Pripstein, M.; Robrish, P.; Shapiro, G.; Steiner, H.; Wahlig, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1973. Contract W-7405-eng-48. 16p. (CONF-730943-11). Dep. NTIS $3.00.

From 2nd international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

Measurements of the polarization parameter for the reaction $\pi^-p \to \pi^0n$ were made at the five momenta 1.03, 1.245, 1.44, 1.59, and 1.79 GeV/c. A polarized target was used, with polarizations achieved ranging from 48 to 57%. Salient features of the experiment were the use of neutron counters for time-of-flight measurements as well as angular information and the use of optical spark chambers, seven to eight radiation lengths thick, for the detection of the γ rays from the decay of the π^0. The center-of-mass angular range covered by the 20 neutron counters was typically $-.78 < \cos\theta_{c.m.} < .87$. For each momentum there are approximately 10,000 events which fit $\pi^-p \to \pi^0n$ with a confidence level of at least 10%. (auth)

25253 (SLAC-Trans-163) NATURE OF THE A_3 MESON. Beketov, G. V.; Zombkovskii, S. M.; Kaidalov, A. B.; Konovalov, B. S.; Kruchinin, S. P.; Pozhidaeva, N. A.; Selektor, Ya. M.; Turov, V. F.; Shulyachenko, V. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. Translation of ITEF-57. 22p. Dep. NTIS $3.25.

Liquid-hydrogen bubble chambers were used to investigate the production of the A_3 meson in the $\pi^-p \to p\pi^+\pi^-\pi^-$ reaction at 4.5 GeV/c and the results were compared with the predictions of the Regge pole-exchange model. The model provides a very good description, in absolute cross sections, of all the principal production and decay features of the A_3 meson (height and shape of the A_3 peaks in the mass spectra of the 3π and $f\pi$ systems, the transferred-momentum distribution, the angular distribution of the normal to the $A_3 \to f\pi$ decay plane, the angular distribution for the f-meson decay from the A_3 enhancement, and the Treiman–Yang angular distribution). All the data are thus in agreement with the assumption that the A_3 enhancement is to a considerable extent a kinematic reflection of peripheral diagrams. The conservation of helicity during A_3 meson production in the $\pi^-p \to A_3^-p$, $A_3^- \to f^0\pi^-$ reaction was also considered. It was found that neither the s-channel nor the t-channel helicities were conserved for this reaction. The above model reproduces these experimental features. (auth)

25254 (UH-511-159-73) NON-STRANGE BOSON SPECTRUM ABOVE 1.5 GeV. Wohlmut, P. G.; Yee, A. K. S.; Johnson, A. D.; Peters, M. W.; Stenger, V. J. (Hawaii Univ., Honolulu (USA).

Dept. of Physics and Astronomy). Jul 1973. Contract AT(04-3)-511. 15p. Dep. NTIS $3.00.

The mass spectrum above 1.5 GeV for the boson X^- in the reaction $\pi^-p \rightarrow X^-p$ at 11.9 GeV/c is examined in a wide variety of multipion configurations. One observes a broad R(1700) signal, but the existence of the S, T, and U mesons is not verified. (auth)

25255 COHERENT K^+d INTERACTIONS BETWEEN 0.64 AND 1.51 GeV/c. BGRT Collaboration. (BGRT Collaboration). Nucl. Phys., B68: No. 2, 285-300(1974).

Data are presented at 13 momenta between 0.64 and 1.51 GeV/c for the coherent processes $K^+d \rightarrow K^+d$, $K^+d \rightarrow K^0d\pi^+$ and $K^+d \rightarrow K^+d\pi^+\pi^-$. Distributions for K^+d elastic scattering are given in the $(0.03 < |t| < 0.22)$ $(GeV/c)^2$ range. (auth)

25256 CHARACTERISTICS OF EVENTS FROM THE π^-p INTERACTIONS AT p = 40 GeV/c. Alma-Ata-Budapest-Bucharest-Warsaw, Dubna-Kharkov-Moscow-Sofia-Tashkent-Tbilisi-Ulan-Bator-Hanoi Collaboration. Yadern. Fiz.; 19: No. 1, 103-114(Jan 1974). (In Russian).

The asymmetry in the production of the secondary particles from π^-p interactions is analyzed at 40 GeV/c. The asymmetry is used to show that there exist two classes of π^--meson interactions with protons. In the first class particles are produced from a point at rest in the c.m.s. (the symmetrical S-events), in the second class they are produced from a moving in the c.m.s. point having the Lorentz-factor $\langle\bar{\gamma}\rangle = 1.48 \pm 0.02$ (asymmetrical AS-events). (50 ± 2)% of all events are treated as S-events and (38 ± 2)% – as AS-events. The features of the S and AS-events (the structure function, multiplicity, mean energies of particles) are studied in a way as they decrease in the forward and backward semispheres. It is shown that in the rapidity y^* distribution the mean differences of rapidities $\langle\Delta y^*\rangle$ between each of boundary and the nearest to it particles are larger than between inner particles at all multiplicities from 4 through 10. (auth)

25257 SLOPES AND BREAKS OF TRANSVERSE-MOMENTUM-SQUARED DISTRIBUTIONS IN 16 GeV/c π^-p INTERACTIONS. Aachen-Berlin-Bonn-CERN-Krakow-Heidelberg-Warsaw Collaboration. Nucl. Phys.; B68: No. 1, 29-43(1974).

Distributions of transverse momentum squared of pions and protons produced in π^-p collisions at 16 GeV/c are studied both for final states of different charged multiplicities and for the inclusive reaction. It is shown that all inclusive distributions have a characteristic concave shape that can be described by the sum of a steeper and a flatter exponential component, with crossing point at about $p_T^2 = 0.2$ $(GeV/c)^2$. The study of the semi-inclusive reactions indicates that this two-component behavior originates in low-multiplicity channels ($n_c \leq 6$). The steep component of π^+ and π^- spectra for channels of low charged multiplicities is studied in detail by comparing the observed sharp dependence of the slope upon the effective mass of the nucleon-pion system, with the corresponding results obtained for Monte-Carlo events. It is found that energy/momentum conservations, together with limitation of transverse momenta, give a quantitative description of these results. However, to justify the relative amount of steep and flat components in the inclusive spectra, the dynamics of resonance production are to be considered. (auth)

25258 SOME RESULTS ON CORRELATIONS IN PARTICLE PRODUCTION IN PION–PROTON INTERACTIONS AT 40 GeV/c. Alma Ata Bucharest–Budapest–Cracow–Dubna–Hanoi–Moscow–Sofia–Tashkent–Tbilisi–Ulan Bator–Warsaw Collaboration. Phys. Lett.; 48B: No. 3, 277-279(4 Feb 1974).

The two-pion correlation function for inclusive pion–proton interactions at 40 GeV/c is studied. The value of the correlation length turns out to be 1.8 ± 0.2. It is suggested that limiting behavior in pion–proton collisions is reached earlier than in proton–proton collisions. (auth)

25259 MEASUREMENT OF THE CROSS SECTIONS FOR REACTION $\pi^-p \rightarrow X^0n$ IN THE MOMENTUM RANGE UP TO 50 GeV/c. Bolotov, V. N.; Isakov, V. V.; Kachanov, V. A.; Kakauridze, C. D.; Prokoshkin, Yu. D.; Rasuvaev, E. A.; (Inst. for High Energy Physics, Serpukhov, USSR). Phys. Lett.; 48B: No. 3, 280-284(4 Feb 1974).

The cross sections for the reaction $\pi^-p \rightarrow X^0n$, $X^0 \rightarrow 2\gamma$ are measured at 32.5 and 48 GeV/c momenta. The spark spectrometer for γ quanta was used to select events of reaction, whose cross section is only about 0.05 μbarn. The cross section energy dependence has the power form $(\sim P^{-1.11\pm0.12})$. A conclusion on U(6) symmetry of the quark model is made when comparing the differential cross sections at zero angle for the reactions $\pi^-p \rightarrow X^0n$ and $\pi^-p \rightarrow \eta^0n$. The angle of octet–singlet mixing for pseudoscalar mesons $\beta = -(20.6 \pm 2.2)^\circ$ is defined. (auth)

Particle Interactions and Properties (Theoretical)

General

25260 (COO-2232-42) REPORT OF TECHNICAL PROGRESS [ON HIGH-ENERGY PHYSICS]. Pais, A. (Rockefeller Univ., New York (USA)). 1974. Contract AT(11-1)-2232. 10p. Dep. NTIS $3.00.

Research on theoretical high energy physics is summarized including results from unitarity, positivity, crossing, etc., gauge theories, chiral symmetry and its breaking, and phenomenology. (JFP)

25261 (COO-3533-29) LECTURES ON DUAL RESONANCE MODELS. Part Five. Spin. Frampton, P. H. (Syracuse Univ., N.Y. (USA). Dept. of Physics). 1973. 72p. (SU-4205-29). Dep. NTIS $5.75.

The step from the conventional multiparticle dual model, taken with unit intercept, to the Ramond-Neveu-Schwarz (RNS) model represents an improvement in several properties. In the boson sector, one now has introduced G-parity with different families of trajectories in the even and odd G-parity channels. The rho trajectory has positive intercept and no tachyon. Extra degrees of freedom were added without introducing ghost states. Most encouragingly, there is some qualitative similarity between the low-mass boson spectrum and experiment. There is now a fermion sector, hitherto absent, and here again extra anticommuting modes lead to no added ghosts. To be fair one should emphasize the shortcomings (which are reasonably obvious): the leading intercepts $\alpha_\rho(0) = 1$, $\alpha_\pi(0) = 1/2$ and $\alpha_f(0) = 1/2$ are all unphysical and all fermions above the ground state are parity doubled. In spite of these difficulties, the importance of RNS theory is firstly that it shows there is no essential theoretical difficulty in introducing fermions, and secondly that it provides food for thought towards the construction of a realistic theory. (auth)

25262 (JINR-P2-7598) LONG RANGE CORRELATIONS AND MULTIPERIPHERAL FIREBALL PRODUCTION. Bassetto, A.; Ranft, G.; Ranft, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 25p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

Long range correlations are obtained within the multiperipheral exclusive model of production of fireballs with mass increasing logarithmically with energy. These correlations are not asymptotically relevant unless peculiar energy dependences of the vertices are postulated. It is concluded that long range correlations respecting KNO scaling are presumably due to nonmultiperipheral fireballs. (auth)

25263 (NP-19858) STRONG INTERACTION AT VERY HIGH ENERGIES. Satz, H. [nd]. 61p. (In German). Dep. NTIS (U. S. Sales Only) $5.25.

The physical principles and mathematical methods on which the description of the interaction between elementary particles is based are reviewed. In succession elastic scattering, inelastic processes, inelastic diffractive processes, and multiple excitation, and inclusive reactions are then considered. (JSR)

Electromagnetic

25264 (JINR-P1-7557) DEEP INELASTIC LEPTON–PROTON SCATTERING AND μ-e UNIVERSALITY. Bilen'kaya, S. I.; Kazarinov, Yu. M.; Lapidus, L. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 8p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

In order to check the μ-e universality at high energies and the momentum transfer the statistical analysis of both μ-p and e-p deep inelastic interaction was made. Differential cross sections for deep inelastic scattering of leptons are given with the help of the structure functions W_1 and W_2. The conclusions are as follows: 1. Data on μ-p and e-p are in accordance if the renormalization of μ-p data is allowed. 2. The values of the coefficients a_i and c_i from μ-p and e-p data coincide within errors with the values of these parameters obtained on the basis of e-p data only. 3. The value of N_μ does not depend within errors on parameterization for R. 4. Apparent difference in cross sections for μ-p and e-p deep inelastic scattering is due probably to systematic errors and does not indicate deviation from the μ-e universality. Further μ-p experiments are desirable. (LBS)

25265 (JINR-P2-7532) TRANSFORMATION PROPERTIES OF FOUR-MOMENTUM ELECTROMAGNETIC FIELD. Polubarinov, I. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A general expression is obtained for the 4-momentum of the electromagnetic field of a moving charge. This expression includes, as particular cases, the Abragam and Fermi results. It is shown that relativity, similar to relativity of the length, is characteristic of this value. (auth)

25266 DIAGONALIZING TENSOR COVARIANTS, LIGHT-CONE COMMUTATORS, AND SUM RULES. Lo, C.Y. (Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). Phys. Rev. D 8: No. 8, 2650-2667 (15 Oct 1973).

We derive fixed-mass sum rules for virtual Compton scattering including the nucleon spin and not specializing to the forward direction. We use the methods of both Dicus, Jackiw, and Teplitz (for the absorptive parts) and Heimann, Hey, and Mandula (for the real parts). We find a set of tensor covariants such that the corresponding scalar amplitudes are proportional to simple t-channel parity-conserving helicity amplitudes. We give a relatively complete discussion of the convergence of the sum rules in a Regge model. (auth)

25267 SCATTERING OF VECTORIAL PARTICLES WITH AN ORIENTATED SPIN. Kostarev, A. I.; Ferents, P. R. (Odessa Pedagogical Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 10, 108-111(1973). (In Russian).

The polarization effects of vectorial particles in a magnetic field with Gaussian distribution of the intensity and in a central "screened" field of the Wentzel-Yukawa type were examined. It was shown that at low momentum of the nonpolarized beam interacting with the first field, in contrast to the scattering of the central field, the limiting transition from the relativistic-vectoral to the scalar state is impossible. (tr-auth)

25268 RADIATION AND ABSORPTION OF SOFT PHOTONS IN MAGNETIC FIELD. Pavlenko, Yu. G. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 10, 91-94(1973). (In Russian).

The known soft-photon approximation was generalized by systems of electrons existing in a constant magnetic field. (tr-auth)

25269 WEAK-INTERACTION EFFECTS IN $\eta \to \pi^+\pi^-\gamma$. Herczeg, P.; Singer, P. (Department of Physics, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). Phys. Rev. D 8: No. 11, 4107-4116 (1 Dec 1973).

Parity-violating effects due to the strangeness-conserving nonleptonic weak interaction are studied in the process $\eta\ (X^0) \to \pi^+\pi^-\gamma$. The circular polarization and the parity-violating linear polarization are calculated in the framework of the Cabibbo theory by using a pole model for the strong and electromagnetic interactions. The isoscalar ($\sim\cos^2\theta$) and isovector ($\sim\sin^2\theta$) components of the weak Hamiltonian are found to give comparable contributions. The magnitude of the circular polarization is obtained to be $(1\text{–}5) \times 10^{-9}$ and the linear polarization, being dependent on final-state interactions, is smaller by nearly two orders of magnitude. In theories with a large isovector component in the weak nonleptonic Hamiltonian (theories involving neutral currents or second-class currents) the circular polarization can be larger, an estimate giving $(1\text{–}3) \times 10^{-8}$. (auth)

25270 INELASTIC FORM FACTORS OF THE PROTON IN ep, πp, AND pp SCATTERING. Hori, S.; Kawaguchi, N. (Osaka Univ., Toyonaka, Japan). Progr. Theor. Phys. (Kyoto); 50: No. 3, 899-914(Sep 1973).

In order to find a "similarity" among inelastic ep, πp and pp scattering, the experimental data of multiparticle production processes are analyzed. In ep and πp scattering, it is shown that inelastic form factors of the proton are common to these two processes, independently of the incident particles, and except for over all strength. By making use of the result, fragmentation and pionization cross sections of pp scattering are estimated. As a result, it is found that $\sigma_{\text{frag}} \simeq \frac{1}{4}\sigma_{\text{tot}}$ and $\sigma_{\text{pion}} \simeq \frac{1}{2}\sigma_{\text{tot}}$, and these are almost independent of the c.m. squared energy s for large s. (auth)

25271 ENERGY INDEPENDENT PARTIAL WAVE ANALYSIS OF SINGLE PION PHOTOPRODUCTION IN THE FIRST RESONANCE REGION. Suzuki, S.; Kurokawa, S. I.; Kondo, K. (Tokyo Univ.). Nucl. Phys., B68: No. 2, 413-432(1974).

Results of an energy independent multipole analysis of π^+, π^0 and π^- photoproduction on nucleons for photon energies between 240 MeV and 500 MeV are presented. New data which are included in the present analysis are the asymmetry by polarized photons for $\gamma n \to \pi^- p$ and the π^-/π^+ ratio recently measured at Tokyo. Each isospin part of the $l \leq 1$ amplitudes has been parametrized; the $2 \leq l \leq 3$ amplitudes have been fixed to the values given by Berends, Donnachie and Weaver, and the $l \geqq 4$ amplitudes have been approximated by the Born terms. Imaginary parts of $l \leqq 3$ amplitudes have been calculated from the real parts by Watson's theorem. Without any isotensor current or anomalous energy dependence of non-resonant multipoles, a good fit to the π^+, π^0 and π^- photoproduction was obtained. The results are compared with dispersion theoretical calculations and phenomenological multipole analyses. $M_{1-}^{\frac{1}{2}}$ is small and consistent with the dispersion theory of Schwela but contradicts the previous results of Pfeil and Schwela. The strong energy dependence of $E_{0+}^{\frac{3}{2}}$ given by Noelle and Pfeil is not justified. Discrepancies between our analysis and dispersion theories occur in the magnitude of $M_{1-}^{\frac{1}{2}}$ and in the energy dependences of $E_{0+}^{\frac{3}{2}}$, $E_{0+}^{\frac{1}{2}}$ and $E_{1+}^{\frac{1}{2}}$. Above 400 MeV two types of solution have been obtained. It is pointed out that the measurement of polarized target asymmetry for $\gamma p \to \pi^0 p$ will distinguish the two solutions. (auth)

25272 PARTICULAR CASES OF PARTICLE PRODUCTION IN INELASTIC LEPTON (ANTI) LEPTON SCATTERING. Bonneau, G.; Martin, F. (Univ., Paris). Nucl. Phys., B68: No. 2, 367-386(1974).

As in a previous paper the inclusive reactions $e + e \to e + e$ + anything are considered in the two photon exchange approximation. The complete calculation of the differential cross section $d\sigma/dW^2$ for the production of a state of effective mass W is presented and the expression for the total cross section is given. This is applied to the muon pair and the pseudoscalar meson (π^0, η and η') productions. (auth)

25273 ANNIHILATION PROCESS $e^+ + e^- \to \gamma$ + HADRONS. Buchl, R. A.; Nigam, B. P. (Arizona State Univ., Tempe). Particles Nucl.; 6: No. 4, 113-118(Oct 1973).

The cross section for the annihilation process $e^+ + e^- \to \gamma +$ hadrons is calculated. Structure functions for the photon are defined by $\overline{W}_1^{\gamma}(\nu,q^2)$ and $\overline{W}_2^{\gamma}(\nu,q^2)$. Crossing symmetry is examined to relate these structure functions to those for the electroproduction process. A statistical fragmentation model is invoked for the behavior of these structure functions. (auth)

25274 BREAK-DOWN OF SCALING IN $e^- + e^+ \to$ HADRONS AND EXTENDED VECTOR DOMINANCE. Dominguez, C. A.; Zepeda, A. (Centro de Investigation y de Estudios Avanzados del IPN, Mexico City). Lett. Nuovo Cim.; 9: No. 7, 273-276(16 Feb 1974).

It is shown that by a simple modification of a special set of relations among the masses, widths, and photon-vector-mesons coupling a breakdown of scaling is predicted in $e^+ + e^- \to$ hadrons from the extended vector dominance model. (LBS)

25275 THEORY OF RADIATION BY AN ELECTRICALLY CHARGED PARTICLE MOVING IN A CONSTANT ELECTRIC FIELD. Kukanov, A. B.; Konstantinovich, A. V. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 5, 627-629(1973). (In Russian).

A method for the calculation of the spectral-angular distribution of x radiation based on the use of the formula $W = -(j\ E)\ dr$ is discussed. Expressions were obtained for the angular distribution of the total radiation. (JSR)

25276 COHERENCE EFFECTS IN SYNCHROTRON RADIATION. Gal'tsov, D. V.; Losev, V. A.; Sokolov, A. A. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 5, 614-616(1973). (In Russian).

Analysis of the coherence effects in synchrotron radiation showed that the intensity of the coherent radiation of N particles, uniformly distributed around a circle, in the relativistic ($\beta \sim 1$) case is always no greater than the intensity of incoherent radiation of N particles. At $N \to \infty$ the radiation disappears completely. (tr-auth)

25277 BACKGROUND IN REACTIONS $\gamma N \to N\pi$ IN THE ENERGY RANGE UP TO 1.5 GeV. Krivets, A. G.; Nikiforov, V. I.; Sanin, V. M.; Shalatskii, S. V. (Physical-Technical Inst., Kazan). Yadern. Fiz.; 19: No. 1, 215-217(Jan 1974). (In Russian).

It is noted that the general behavior of the cross sections for the reaction $\gamma N \to N\pi$ in the photon energy range up to 1.5 GeV in the total and electric Born approximation does not change essentially and remains in a sharp contradiction to the experiment. It is found that the contradiction is due to anomalous great contributions from transitions with the total angular momentum $J = \frac{3}{2}$ in the reactions $\gamma N \to N\pi^{\pm}$ and with $J = \frac{1}{2}, \frac{3}{2}$ in the reactions $\gamma N \to N\pi^0$. It is shown that a resonance model where the background consists of the total Born amplitude without the mentioned transitions provides a reasonable agreement with the experimental cross sections in the whole ranges of angles and energies up to 1.5 GeV. (auth)

25278 O(3,1) SYMMETRY MODEL AND PROTON-COMPTON SCATTERING BETWEEN 2.2 AND 7.0 GeV. Saleem, M.; Tirmazi, S. H.; Kamran, M. (Univ. of the Punjab, Lahore). Progr. Theor. Phys. (Kyoto); 50: No. 4, 1413-1414(Oct 1973).

It is shown that the differential cross sections of the proton-Compton scattering obtained in a coincidence experiment at photon energies between 2.2 and 7.0 GeV and for the four-momentum transfer squared, -t, between 0.10 and 0.85 $(GeV/c)^2$ are consistent with the O(3,1) symmetry model. (LBS)

25279 INDUCED TWO-PHOTON PRODUCTION OF ELECTRON−POSITRON PAIRS IN MAGNETIC FIELD. Zhukovskii, V. Ch.; Nikitina, N. S. (Moscow State Univ.). Yadern. Fiz.; 19: No. 1, 148-154(Jan 1974). (In Russian).

Production of e^-e^+ pair in collision of a γ quantum with plane electromagnetic field in a static magnetic field is considered. The probability of the process is obtained with account of polarization states of the photons, the electrons and the positrons. It is shown that the magnetic field results in polarization of the produced electrons and positrons and that the reaction is possible at the photon energies below the two-photon pair production threshold in the vacuum. (auth)

25280 DETERMINATION OF PHOTON POLARIZATION FROM ASYMMETRY OF THE RECOIL ELECTRONS IN TRIPLETS. Boldyshev, V. F.; Peresun'ko, Yu. P. (Physical-Technical Inst., Kazan). Yadern. Fiz.; 19: No. 1, 144-147(Jan 1974). (In Russian).

Values are calculated of maximal azimuthal asymmetry of differential in the recoil electron momentum effective cross section of the electron−positron pair photoproduction on electrons (triplets). The asymmetry is calculated with account of the minimal detected recoil momentum in the interval from 0 up to 1.25 MeV/c. The results are presented in a table for the photon energies of 100, 200, 500, and 1000 mc^2 (m is the electron rest mass). (auth)

25281 DISPERSION METHOD OF CALCULATING THE RADIATIVE CORRECTIONS IN UNIFIED GAUGE THEORIES OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Bogomol'nyi, E. B.; Shifman, M. A. (Moscow Physical-Technical Inst.). Yadern. Fiz.; 19: No. 1, 169-175(Jan 1974). (In Russian).

It is discussed how to calculate the radiative corrections in gauge theories of weak and electromagnetic interactions using no gauge-invariant regularization. The presented method uses both the dispersion relations and unitarity conditions and permits the radiative corrections to be calculated in arbitrary gauge including the unitary (i.e. nonrenormalizable) gauge. The method is used for calculation of the muon (g−2) in Weinberg model. The result coincides with that obtained in a usual way. (auth)

25282 DEPENDENCE OF THE CROSS SECTION OF THE PROCESSES $\gamma\gamma \to \pi\pi$ AND $\gamma\gamma \to \gamma\gamma$ UPON THE CHOSEN PARAMETRIZATION OF $\pi\pi$ SCATTERING PHASES. Isaev, P. S.; Khleskov, V. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 1, 121-126(Jan 1974). (In Russian).

The effects of various parametrizations and of the asymptotic value of the $\pi\pi$ scattering phases on the calculated cross sections of the processes $\gamma\gamma \to \pi\pi$ and $\gamma\gamma \to \gamma\gamma$ are investigated. It appears to be important to include the general solution of the homogeneous integral equation when solving the singular dispersion equation for the $\pi\pi$ scattering phases with non-zero asymptotics. (auth)

25283 α^3 CONTRIBUTIONS TO THE ANOMALOUS MAGNETIC MOMENT OF AN ELECTRON IN THE MASS-OPERATOR FORMALISM. Carroll, R. (Univ. of Michigan, Ann Arbor); Yao, Y. P. Phys. Lett.; 48B: No. 2, 125-127(21 Jan 1974).

The α^3 contributions to (q−2)/2 of an electron due to graphs without electron loop(s) are evaluated numerically by the mass operator formalism. Our result is 0.74(6) $(\alpha/\pi)^3$. (auth)

25284 EIKONAL MODEL FOR NEUTRAL PION PHOTOPRODUCTION INCLUDING REGGEON−REGGEON CUTS. Collins, P. D. B.; Fitton, A. (Univ. of Durham, Eng.). Nucl. Phys.; B68: No. 1, 125-138(1974).

The experimental data on the high-energy processes $\gamma p \to \pi^0 p$, $\gamma n \to \pi^0 n$ and $\gamma p \to \eta p$ were fitted with just the ρ and ω Regge poles, and strong absorptive cuts generated by the P + P′ exchange amplitude from πN elastic scattering. Excellent agreement was obtained with all the data, including target and photon asymmetries, without invoking secondary reggeons was obtained such as the B or H trajectories. This result, together with earlier work on the πN charge exchange scattering, leads us to conclude that the addition of $P' \otimes$ reggeon cuts can solve many of the phase problems of the traditional SCRAM model. (auth)

25285 INVESTIGATION OF THE PHASE OF THE ELECTROMAGNETIC PION FORM FACTOR IN THE ASYMPTOTIC REGION. Shcherbin, Yu. P. (Leningrad State Univ.). Nucl. Phys.; B68: No. 2, 532-540(1974).

The phase of the electromagnetic pion form factor G(t) in the asymptotic region $(t > 1(GeV)^2)$ is investigated by the dispersion sum-rule method. Using experimental data for G(t) at $t < 1\ (GeV)^2$ it is found that the mean weighted value of the asymptotic phase does not show strong deviations from the asymptotic value of the phase coming from an extrapolation of the data from the ρ-resonance region with the help of the Gounaris−Sakurai formula. The contribution of the hypothetical ρ-like resonances to the dispersion sum rules is roughly estimated. These estimates and the results of the calculation of the dispersion sum rules show that the existence of strong ρ-like elastic resonances is forbidden in the 1−1.7 GeV $\sqrt{t}$ range at least. (auth)

25286 HARD PHOTON CORRECTIONS FOR BHABHA SCATTERING. Berends, F. A. (CERN, Geneva); Gaemers, K. J. F.; Gastmans, R. Nucl. Phys.; B68: No. 2, 541-550(1974).

Numerical results for the α^3 differential cross section for $e^+e^- \to e^+e^-$ are presented for the case of e^+e^- colliding beams. Special care is given to the hard photon corrections. Acoplanarity distributions for $e^+e^- \to e^+e^-\gamma$ are also presented. Attention is drawn to experimental conditions which require the calculation of still higher order corrections. (auth)

25287 MULTIPLICITIES AND FORM FACTORS IN AN INDEPENDENT EMISSION MODEL OF e^+e^- ANNIHILATION. Ferrara, S. (CNEN, Frascati, Italy); Stodolsky, L. Phys. Lett.; 48B: No. 3, 249-252(4 Feb 1974).

e^+e^- Annihilation is considered with the object of obtaining some simple relations between the multiplicities in annihilation and form factors of the hadrons. Reasons are discussed for making the following three assumptions (a theorem of the Phragmen−Lindeloef type is utilized): Poisson behavior for all channels in $e^+e^- \to$ hadrons, $\bar{n} = c \ln q^2$, and point-like total hadron cross section in annihilation. It is concluded that form factors fall as a power asymptotically (up to $\ln q^2$ factors) and this power is the same for all particles; if in e^+e^- annihilation, $p\bar{p}$ production is small relative to pion production, then the constant $d\sigma(ep \to ep)/d\sigma(e\pi \to e\pi) \ll 1$ at high q^2, spacelike; and the power of the form factor is governed by the multiplicity growth parameter c. (RWR)

Weak

25288 (BNL-18525) ELECTROMAGNETIC AND WEAK INTERACTIONS AT ISABELLE. Lederman, L. M. (Brookhaven National Lab., Upton, N. Y. (USA)). Jan 1974. 13p. Dep. NTIS $3.00.

A survey is given of the present status and expectations for studying $\mu^\pm$ and $W^\pm$ production in pp interactions using the Isabelle muon detector. A brief description is given of the experimental arrangement. Some predictions based on the Drell-Yan parton−antiparton annihilation model and the modified Drell-Yan model are discussed. (LBS)

25289 SINGULAR CORES IN THE THREE-BODY PROBLEM. II. NUMERICAL SOLUTION. Brayshaw, D.D. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 8: No. 8, 2572-2578 (15 Oct 1973).

The formalism for singular cores previously introduced is investigated numerically for a simple model. Calculations of three-particle binding energies and the analog of N-d scattering for this model demonstrate the practicality of the earlier theoretical development. (auth)

25290 NEUTRINO DIFFERENTIAL CROSS SECTION$(d\sigma/dQ^2)$ PREDICTIONS AS A FUNCTION OF INTERMEDIATE BOSON (W) MASS. Bergamasco, L. (Consiglio Nazionale delle Ricerche, Turin); D'Ettorre Piazzoli, B.; Picchi, P.; Visentin, R. Lett. Nuovo Cim.; 9: No. 6, 224-230(9 Feb 1974).

The differential cross section $d\sigma/dQ^2$ for the interactions of neutrinos at energies $E_\nu = 100$, 200, and 500 GeV on Ne nuclei is calculated for different values of the intermediate boson mass M_W. It is concluded that for $E_\nu = 100$ GeV it is possible to carry out experimental measurements which can evidence masses M_W of about 15 to 20 GeV. (LBS)

25291 DYNAMICAL MODEL FOR THE K_{l3} SCALAR FORM FACTOR. Bhamathi, G. (Univ. of Madras); Raghavan, S.; Gourishankar, R. Lett. Nuovo Cim.; 9: No. 6, 235-241(9 Feb 1974).

It is shown that if inelastic effects are introduced in the $K\pi$ scattering amplitude and in addition the $K-\pi$ mass differences are preserved a small negative value for the slope parameter of the scalar form factor can be obtained by just using the conventional kappa resonance dominance. (LBS)

25292 THEORETICAL CROSS-SECTIONS OF SINGLE W-BOSON PRODUCTION IN PHOTON−ELECTRON COLLISIONS AND IN ELECTRON−POSITRON COLLIDING BEAM EXPERIMENTS. Hayashi, M. (Saitama Medical Coll., Moroyama, Japan). Acta Phys. Pol.; B5: No. 1, 97-103(1974).

Total cross section for the production of single W-boson in high energy photon-electron collisions is computed in the limit $m_e \to 0$. Applying the Weizsäcker−Williams approximation, the asymptotic formulas for the total cross-sections of single W-boson production in high energy electron-positron colliding beam experiments are obtained. (auth)

25293 LEPTON–HADRONIC INTERACTIONS AND HIGGS' SCALAR PARTICLES. Nikolaev, N. N.; Shmatikov, M. Zh. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 19: No. 1, 176-181(Jan 1974). (In Russian).

The corrections to the interaction of charged weak currents in gauge models of weak interactions are considered due to exchange of Higgs' scalar particles. The corresponding corrections to the Treiman–Callan relation are also treated for the K_{l3}-decay form factors and the possible appearance of the effective scalar is considered in the μ-capture matrix element with a constant $G_S \sim 0.1\ G_F$. (auth)

25294 THEORETICAL INTERPRETATION OF RESULTS ON NEUTRAL CURRENTS IN INCLUSIVE NEUTRINO REACTIONS. Sehgal, L. M. (Technische Hochschule, Aachen). Phys. Lett.; 48B: No. 2, 133-136(21 Jan 1974).

The experimental results on the neutral current reactions $\nu_\mu(\bar{\nu}_\mu)$ + nucleon $\rightarrow \nu_\mu(\bar{\nu}_\mu)$ + hadrons are compared with the expectations of the Weinberg–Salam theory as calculated in a parton model. Remarkable consistency is obtained. The data indicate a value for the parameter $\sin^2\theta$ close to 0.3. Some further tests are suggested. (auth)

25295 LIMITS TO SECOND-CLASS CURRENTS. Wilkinson, D. H. (Oxford Univ.). Phys. Lett.; 48B: No. 2, 169-172(21 Jan 1974).

Experimental asymmetries in Gamow–Teller mirror β-decay yield limits on Kubodera, Delorme and Rho's second-class current parameters: $|\zeta| < 2.5 \times 10^{-3}$ MeV^{-1}, $|\lambda| < 10 \times 10^{-3}$. (auth)

25296 WEAK NEUTRAL CURRENTS IN ATOMIC PHYSICS. Bouchiat, M. A. (Ecole Normale Superieure, Paris); Bouchiat, C. C. Phys. Lett.; 48B: No. 2, 111-114(21 Jan 1974).

Possible ways of detecting weak neutral currents in atomic physics through parity-violating effects in heavy atoms are analyzed from a theoretical point of view. (auth)

25297 ASTROPHYSICAL UPPER BOUNDS ON NEUTRINO–NUCLEON CROSS SECTION AT ENERGY $E \geq 3 \times 10^{17}$ eV. Berezinski, V. S.; Smirnov, A. Yu. Phys. Lett.; 48B: No. 3, 269-272(4 Feb 1974).

The possibility of experiments with cosmic neutrinos of energy $E > 3 \times 10^{17}$ eV is discussed. An upper bound on the neutrino–nucleon cross section, $\sigma < 9.3 \times 10^{-30}$ cm^2, was obtained from the zenith angular distribution of extensive air showers under some particular astrophysical assumptions. (auth)

Strong (General)

Refer also to abstract 25944.

25298 COMMENTS ON SEPARABLE POTENTIALS AND COULOMB INTERACTIONS. Shah-Jahan, M. (Atomic Energy Center, P. O. Box-164, Dacca, Bangladesh). Phys. Rev. D 8: No. 8, 2744-2746 (15 Oct 1973).

The scattering of two charged particles via a separable potential has been discussed. It has been shown that equivalent local potentials for a large number of separable potentials in the presence of Coulomb interactions do not exist. (auth)

25299 MULTIPARTICLE GENERATING FUNCTION AND THE FROISSART BOUND. Khuri, N.N. (Rockefeller University, New York, New York 10021). Phys. Rev. D 8: No. 8, 2702-2707 (15 Oct 1973).

Rigorous bounds for $\sigma_{tot}(s)$ and $\sigma_{el}(s)$ in terms of the smallest zero of the multiparticle generating function are derived. It is then shown that, if the analogy between this generating function and the grand partition function of a gas can be carried through to the point of establishing analyticity properties analogous to those established by Ruelle for a classical gas, then the Froissart bound can be improved essentially by lns. It is pointed out that the Ruelle theorem is valid in the multiperipheral model, and the steps needed for studying it in the general case are briefly outlined. (auth)

25300 MASS DIFFERENCES WITHIN SU(3) MULTIPLETS AND RELATIVISTIC QUARK MODEL. Fontannaz, M. (Laboratoire de Physique Théorique et Hautes Energies, Orsay, France). Phys. Rev. D 8: No. 8, 2640-2649 (15 Oct 1973).

The mass differences within SU(3) multiplets are studied in the framework of a relativistic quark model where the hadrons are described by Bethe-Salpeter wave functions. We show that it is necessary to take into account all the effects due to the superstrong coupling between the quarks in order to get results which agree with experiment (mass-breaking parameters depending on L, S, and J, splitting of the Σ and Λ masses, etc.). We apply the model to the $L = 0$, $L = 1$ mesons and to the $(1/2)^+$ and $(3/2)^+$ baryons. (auth)

25301 PARASTATISTICS AND THE QUARK MODEL. Bracken, A.J.; Green, H.S. (Department of Mathematical Physics, University of Adelaide, Adelaide, S. Australia). J. Math. Phys. (N.Y.) 14: No. 12, 1784-1793 (Dec 1973).

An extension of ordinary parastatistics is considered which makes use of all the representations of the parastatistics algebra obtained from the usual ansatz. Govorkov's demonstration that such an extension, for parastatistics of order 2, implies a U(2) symmetry, is generalized for parastatistics of order p. The parastatistics algebra, restricted to N dynamical states, is characterized by the irreducible representations of U(N), SO(2N), and SO(2N + 1) which it contains. It is shown that these representations have multiplicities equal to the dimensions of associated representations of U(p), O(p) and C(p), respectively, where C(p) is a subalgebra of the enveloping algebra of O(p), but is not a Lie algebra. The symmetric group S(p) also appears, as a subalgebra of the enveloping algebra of C(p). It is shown how a nondegenerate vacuum state may be defined for the generalized parastatistics algebra of order p, and how to construct state vectors corresponding to arbitrary numbers of quarklike particles and antiparticles. Such states belong to irreducible representations of U(N), and can be obtained by the application of one kind of creation and annihilation operators to certain basic states, here called reservoir states, which correspond to the different irreducible representations of SO(2N + 1). The specialization to parastatistics of order 3 is discussed in detail with the application to a quark model of the hadrons in view. It is shown how to define isospin and hypercharge in a significant way in this model, which, however, differs in some respects from Gell-Mann's well-known 3-fermion model, and also from Greenberg's 3-parafermion model. Some of the physical implications are examined. (auth)

25302 ANALYSIS OF TWO PARTICLE RAPIDITY CORRELATIONS AT ISR ENERGIES. Hayot, F.; Morel, A. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys., B68: No. 2, 323-330(1974).

The short range two particle rapidity correlations at ISR energies are interpreted in terms of clustering effects in the central rapidity region. It is shown that the experimental data give an indication that large clusters are produced, and as a consequence one should observe short range correlation between π^-'s. The energy dependence of the data is also simply explained. (auth)

25303 DUALITY IN THE CURRENT PROPAGATOR. Gounaris, G. J. (CERN, Geneva). Nucl. Phys., B68: No. 2, 574-584(1974).

The idea of local duality between generalized vector dominance and light cone algebra or parton model is applied to the propagator of vector currents. A set of sum rules reminiscent of the generalized first Weinberg sum rules but involving certain unknown parameters are derived. These parameters are fixed from the leptonic decay modes of ρ, ω, φ. The sum rules are used to calculate the $\omega - \varphi$ mixing angle and thereby predict $\Gamma(\varphi \rightarrow K\bar{K}) = 3.24 \pm 0.34$ MeV, in agreement with experiment. Simple mass mixing or current mixing model for the vector mesons seem to be inconsistent with data. The total cross section for $e^+e^- \rightarrow$ hadrons is calculated in the scaling region. If scaling is achieved at $s \approx 9$-16 GeV^2 then it is argued that about 22% of the events in this energy region will include strange particles. (auth)

25304 RELATIONS IN A FACTORIZING MULTIPERIPHERAL CLUSTER MODEL. Bopp, F. W. (Univ. of Bielefeld, Ger.). Nucl. Phys., B68: No. 2, 551-560(1974).

A multiperipheral cluster model in which the clusters are independently emitted is investigated using the formalism of generating functionals and exact relations between overall correlations and cluster decay spectra are obtained. These relations and the general concept of clusters are subsequently discussed in regard to experimental data. (auth)

25305 TEST OF THE SRO HYPOTHESIS FOR TWO CHARGED PARTICLE CORRELATIONS AND RELATIVE SIZE OF THE DIFFRACTIVE AND NONDIFFRACTIVE COMPONENTS. Hayot, F.; Morel, A. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys., B68: No. 2, 312-322(1974).

It is shown that the SRO hypothesis is well satisfied by the recent ISR data on two charged particle correlations at different energies. Moreover, within the framework of the two component model, the relative amount of diffractive and non-diffractive contributions is determined as a function of the cosmic ray variable η. This leads to a consistent description of the long range correlation. (auth)

25306 QUARK MODEL FOR THE POMERON. Barmawi, M. (Institut of Tech., Bandung, Indonesia); Venturi, G. Lett. Nuovo Cim.; 9: No. 7, 257-260(16 Feb 1974).

A quark model for the pomeron was previously suggested in which the pomeron arises from the effect of a small nonzero third double-spectral function. The model is re-examined and is shown to lead to a consistent picture compatible with t-channel unitarity.

The qualitative structure of the complex angular-momentum λ-plane singularity associated with the pomeron is obtained. (LBS)

25307 STRUCTURE OF QUARKS. Kitazoe, T. (Kobe Univ., Japan). Progr. Theor. Phys. (Kyoto); 50: No. 3, 1092-1094(Sep 1973).

The structure of quarks and properties of their weak and strong interactions are examined on the basis of a similarity of the pure leptonic weak interactions and the semileptonic weak interactions of quarks. In particular, the following are discussed: (a) the origin of a breakdown of the SU(3) symmetry in strong interactions, (b) $\Delta S = \Delta Q$ rule and the difference between interactions for semileptonic weak decays in which $\Delta S = 0$ and $\Delta S \neq 0$, and (c) $\Delta I = \frac{1}{2}$ rule and its small breaking in the nonleptonic decays. (LBS)

25308 INCLUSIVE PROCESSES AND SCALING INVARIANCE AT SMALL DISTANCES. Efremov, A. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 1, 196-202(Jan 1974). (In Russian).

On basis of the hypothesis of scale invariance at small distances a qualitative picture of inclusive processes is obtained in quantum mesodynamics. This picture is close to the multiperipheral one. The Feynman scaling in both the pionization region and the fragmentation region is shown to be not an immediate consequence of the scale invariance. The behaviour at large transverse momenta in the pionization region is of a power law, the exponent being connected with anomalous dimensions of the fields. The distribution in this region is slightly dependent on s, in agreement with the experiment. (auth)

25309 ASYMPTOTIC RELATIONS AMONG STRUCTURE FUNCTIONS IN INCLUSIVE PROCESSES FOR PARTICLES BELONGING TO THE SAME MULTIPLET. Grishin, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 1, 192-195(Jan 1974). (In Russian).

Relations among structure functions for particles belonging to the same multiplet are considered. (auth)

25310 STRUCTURE OF TWO-BODY CORRELATIONS IN HIGH ENERGY HADRON PRODUCTION. Le Bellac, M. (Univ., Nice); Miettinen, H. I.; Roberts, R. G. Phys. Lett.; 48B: No. 2, 115-118(21 Jan 1974).

Experimental information on diffraction is used to estimate long range effects in multiparticle production. Diffractively produced secondaries are found to produce a plateau in the central region. Diffraction accounts for 30% of the observed correlations and the remainder, consistent with being short range, corresponds to a cluster size of 2.4 charged particles. (auth)

25311 QUARK TRIPLETS IN SELF-INTERACTION AND THE LIGHT-CONE STRUCTURE OF CURRENT COMMUTATORS. Minkowski, P. (CERN, Geneva). Nucl. Phys.; B68: No. 1, 139-156(1974).

A field theory of basic quark fields with current-current self-interaction is analyzed with respect to the leading singularity structure of current commutators on the light cone. Canonical leading singularities are found to be compatible with the four-fermion interaction whereas the structure of the bilocal operators differs essentially from the free field case. (auth)

25312 DECAY OF FIREBALLS IN THE STATISTICAL BOOTSTRAP MODEL. Nahm, W. (Univ., Bonn). Nucl. Phys.; B68: No. 1, 111-124(1974).

It is shown that in the statistical bootstrap model the probability of a fireball decay into a given channel does not only depend on the volume of the corresponding phase space but also on the velocity of the decay products. Taking this into account a new integral equation is derived for the decay chain, which is used to determine the mean number of heavy hadrons emitted in the decay chain of a fireball with large mass. (auth)

25313 DUAL QUARK-GLUON THEORY WITH DYNAMICAL COLOR. Schwarz, J. H. (California Inst. of Tech., Pasadena). Nucl. Phys.; B68: No. 1, 221-235(1974).

A modification of a previously proposed dual resonance theory of quarks and gluons is presented. It consists of incorporating new oscillator modes carrying color indices. The specific properties of these operators and the way they are included into the theory are completely determined by various consistency requirements. This modification of the theory has two important consequences. First, quark statistics are properly taken into account. Second, the critical dimension of space-time is reduced to $d = 10 - 2N$, where N is the number of colors. Thus, the physically preferred choices $N = 3$ and $d = 4$ are compatible. (auth)

25314 MODEL OF DIFFRACTIVE SCATTERING. Swiecki, M. (Inst. of Nuclear Research, Warsaw). Nucl. Phys.; B68: No. 1, 12-28(1974).

The possibility of multiperipheral diffractive production of particles is considered. Two possible pictures of scattering arise. The peripheral component of pomeron obtained in that way, is, then, favorably compared with experiment. The possibility of rising cross sections appears in a natural way. (auth)

25315 APPROACH TO SCALING OF INCLUSIVE DISTRIBUTIONS IN THE MULTIPERIPHERAL MODEL. Caneschi, L. (CERN, Geneva). Nucl. Phys.; B68: No. 1, 77-84(1974).

It is shown that the inclusive distributions of produced particles raise to their scaling limit in the MPM as a consequence of the assumed momentum transfer limitation. A quantitative parameter-free estimate of the effect reproduces satisfactorily the observed dependence on s, x and the mass, even when the non-leading Regge trajectories with intercept ~0.5 and positive residues are introduced. The relevance of inclusive phenomenology based on a six-point function approach and of its consequences (like the Ferbel plots) is therefore questioned. (auth)

25316 ABSENCE OF GHOSTS IN THE DUAL FERMION MODEL. Corrigan, E. F.; Goddard, P. (Univ. of Durham, Eng.). Nucl. Phys.; B68: No. 1, 189-202(1974).

The consistency of the dual fermion model is further explored by showing the completeness of the transverse fermion physical states, in various situations, when the fermion ground state mass is zero. To this end the fermion physical state projection operator is constructed. A detailed direct proof of the absence of ghosts is given. The absence of fermion ghosts in twisted configurations is shown to require delicate cancellations. Comparison with the Neveu-Schwarz model indicates possible difficulties with the twisting operator. (auth)

25317 HIGH ENERGY PROPERTIES OF A CLASS OF UNITARY EIKONAL MODELS FOR MULTIPRODUCTION. Redei, L. B. (CERN, Geneva). Nucl. Phys.; B68: No. 1, 177-188(1974).

The high-energy properties of a simple class of unitary, crossing-symmetric eikonal models of multiproduction are discussed on the basis of the general closed expression given for the S-matrix elements in a previous publication. In particular, the high-energy behavior of the multiplicity moments is discussed and it is shown that the KNO scaling relation energies in a very natural fashion in this class of models. (auth)

25318 BOUNDS ON MULTIPLICITY DISTRIBUTIONS FROM ONE-PARTICLE INCLUSIVE SPECTRA. Blaschke, R.; Muetter, K. H. (Univ., Heidelberg). Nucl. Phys.; B68: No. 1, 277-284 (1974).

Using energy conservation sum rules, bounds are derived on multiplicity distributions in terms of one-particle inclusive spectra. (auth)

25319 BOOTSTRAP EQUATIONS FOR FIREBALL DECAY. Chiu, C. B. (Univ. of Texas, Austin); Gleiser, R. J. AT(40-1)-3992. Nucl. Phys.; B68: No. 2, 349-366(1974).

Various bootstrap equations which describe successive decay of fireballs are studied. These equations are generalizations of the original statistical bootstrap equation of Hagedorn and of Frautschi. In particular, the average pion multiplicity as a function of the fireball mass for various kernels, and the constraint due to the conservation of energy on the correlation parameter $f_2 = \langle n(n-1) \rangle - \langle n \rangle^2$ are investigated. This latter constraint tends to give rise to a negative f_2. The pion energy distribution is derived for a constant kernel model. An exponential fall off in this distribution is found in the small energy region. Lastly, a bootstrap equation is presented which includes both the π and the p as the ground states. A possible connection between this model and the slope of the $\langle n_0 \rangle_-$ versus n_- data is given. (auth)

25320 RELATION BETWEEN DIFFRACTIVE PEAKS OF ELASTIC AND EXCITATION PROCESSES. Gordon, E. M.; Hwa, R. C. (Univ. of Oregon, Eugene). AT(45-1)-2230. Nucl. Phys.; B68: No. 2, 433-442(1974).

By considering the anisotropy of the decay distributions of excited clusters, or equivalently their spins, in the diffractive excitation model, it is shown how the forward peak of the differential cross section for excitation is broadened. Furthermore, it is shown through unitarity how the elastic peak is sharpened. An algebraic relation between the slopes is derived. In a self-consistent model, the excitation slope for large cluster masses is half the elastic slope. (auth)

25321 SIMPLE MODEL FOR THE DIFFRACTIVE OVERLAP INTEGRAL. Teper, M. (Westfield Coll., London). Phys. Lett.; 48B: No. 3, 225-226(4 Feb 1974).

A model is introduced for the diffractive overlap integral in which the overlap is represented by a set of nonforward triple Regge diagrams. The formalism provides a clear framework within which to discuss questions concerning the peripherality of diffractive processes. (auth)

25322 QUARK IMPRISONMENT AS THE ORIGIN OF STRONG INTERACTIONS. Amati, D.; Testa, M. (CERN, Geneva). Phys. Lett.; 48B: No. 3, 227-231(4 Feb 1974).

A formal scheme is proposed in which the only dynamical ingredients are weak and electromagnetic interactions with quarks and leptons treated on the same footing. Strong interactions are generated by the requirement that quarks do not appear physically. (auth)

25323 ISOSPIN CONSERVATION AND POISSON-LIKE MULTIPLICITY DISTRIBUTIONS. Kaiser, G. D. (Daresbury Nuclear Physics Lab., Eng.). Phys. Lett.; 48B: No. 3, 235-238 (4 Feb 1974).

Data on charged-particle multiplicities and on the production of neutral particles are used to calculate a lower bound on the dispersion of the distribution of the total number of particles in the final state of hadron--hadron collisions. It is shown that this bound is an approximately linear function of $\langle n_{ch} \rangle$, the mean of the number, n_{ch}, of charged particles in the final state. It is argued that this rules out the possibility that the production of particles can be described by a single "Poisson-like" mechanism, no matter what isospin-conserving hypothesis is used. It is also argued that such models will inevitably fail to reproduce the available data on the mean number of neutrals produced when n_{ch} is known. (auth)

25324 DYNAMICAL APPROACH TO SUCCESSIVE ASYMPTOPIA. Amati, D. (CERN, Geneva). Phys. Lett.; 48B: No. 3, 253-256(4 Feb 1974).

It is argued, on the basis of a multiperipheral dynamics, that the s^α expansion of amplitudes could be appropriate for not too high energies (first asymptotic expansion). At ISR energies the first steps in the building up of the second asymptotic expansion, which would imply $(\log s)^\beta$ behavior, should be observed. (auth)

25325 REGGE-MUELLER ANALYSIS IN THE PIONIZATION REGION. Choudhury, S. R. (Purdue Univ., Lafayette, IN). Phys. Lett.; 48B: No. 3, 246-248(4 Feb 1974).

An attempt to determine the subasymptotic terms in the pionization region of $\pi^\pm$-inclusive reactions by analyzing the rapidity dependence of various cross sections is described. (auth)

25326 EXISTENCE OF THREE SCALING REGIONS AT LARGE TRANSVERSE MOMENTUM. Bander, M.; Barnett, R. M.; Silverman, D. (Univ. of California, Irvine). Phys. Lett.; 48B: No. 3, 243-245(4 Feb 1974).

A model for large $p_\perp$ production yielding three different scaling relations in different regions of s and $p_\perp$ is presented. The couplings may be chosen such that $1/s^4$ scaling is valid at present energies, while at higher energies $1/s^2$ scaling should manifest itself. (auth)

25327 ASYMPTOTIC OSCILLATION HYPOTHESIS. Chew, G. F.; Koplik, J. (Univ. of California, Berkeley). Phys. Lett.; 48B: No. 3, 221-224(4 Feb 1974).

The observed persistence of threshold effects into the Regge asymptotic region of single-particle inclusive cross sections can be accommodated in a natural fashion by complex Regge poles which, if factorizable, will produce asymptotic damped oscillations in a wide variety of other observable quantities. It is shown that a single pair of such poles, the imaginary part of whose position in the complex J plane is of the order ±1, can qualitatively explain various anomalies that have been observed in high-energy phenomena. Predictions are made for future measurements. (auth)

Strong (Baryon No. = 0)

25328 (JINR-E2-7661) LOW ENERGY SCATTERING OF MASSIVE PIONS. Pervushin, V. N.; Volkov, M. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 28p. Dep. NTIS (U. S. Sales Only) $3.50.

Within the theory with chiral type Lagrangian the massive pion scattering amplitude is calculated allowing for the one-loop diagrams. Contributions from the baryon loops are considered, as well. The phase shift analysis of the amplitude is performed. The results obtained by the covariant with respect to the group SU(2) × SU(2) method of calculation of the pion superpropagator and those by the noncovariant one are compared. An effect of the pion mass on behavior of scattering phase shifts is studied. (auth)

25329 COUPLED CHANNEL STUDY OF THE S-WAVE $\pi\pi \to K\bar{K}$ INTERACTION. Johannesson, N. O.; Petersen, J. L. (NORDITA, Copenhagen). Nucl. Phys., B68: No. 2, 397-412(1974).

A dispersion relation type calculation of the I = 0 S-wave amplitude $g_0^+(t)$ for the process $\pi\pi \to K\bar{K}$ was performed, in the region from $t = 4\mu^2$ to $t = (1100\ MeV)^2$. Crossing is imposed by generalizing the newly developed hyperbolic partial-wave relations to the reaction and by imposing them on the amplitude using experimental $K\pi$ phase-shift information as input. Analyticity and unitarity is imposed by generalizing the formalism of Basdevant, Froggatt, and Petersen for parametrizing partial-wave amplitudes. This readily allows use of the experimental $\pi\pi \to K\bar{K}$ cross section. Finally the low energy behavior is constrained to lie within certain limits recently deduced from fixed-t $K\pi$ dispersion relation studies and including the current algebra prediction as a special case. A previous controversy regarding the sign of Im $g_0^+(t)$ can be resolved. (auth)

25330 UNITARY SINGLET e.m. CURRENT, ASYMPTOTIC NONET SYMMETRY, AND VECTOR-MESON DECAYS. Khanna, M. P. (Panjab Univ., Chandigarh, India). Lett. Nuovo Cim.; 9: No. 7, 277-280(16 Feb 1974).

The possibility that the hadronic electromagnetic current may have an SU(3) singlet component is investigated in connection with vector meson decays. The asymptotic nonet symmetry is assumed for the first spectral-function sum rule of Weinberg for the vector currents. The second Weinberg spectral-function sum rule is assumed to have been modified with the broken-SU(3) model of Gell-Mann as a guide. (LBS)

25331 ANALYSIS OF AMBIGUITY IN THE $\pi\pi$-SCATTERING PHASE SHIFT δ_0^0 ON BASIS OF THE DISPERSION RELATIONS. Goloskokov, S. V.; Shirkov, D. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 1, 188-191(Jan 1974). (In Russian).

Ambiguity in the phase shift $\delta_{l=0}^{0}$ is investigated by means of the dispersion relations for the forward scattering amplitude. It is shown that the solution with no resonance near M_ρ is essentially more preferable. The ambiguity in the δ_0^0 phase shift near 1 GeV/c cannot be removed using the available experimental data. (auth)

25332 ANALYSIS OF THE LATEST EXPERIMENTAL DATA ON THE $K \to 3\pi$ DECAY AND AN ESTIMATE OF THE $\pi\pi$ SCATTERING LENGTHS. Volkovitskii, P. E.; Dakhno, L. G. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 19: No. 1, 182-187(Jan 1974). (In Russian).

The theory of the threshold three-particle interaction enables one to determine the pion scattering lengths from the experimental data on the $K \to 3\pi$ decay. The latest experimental data are analyzed in order to find out what confidence may be obtained for the extracted pion scattering lengths. (auth)

25333 QUARK MODEL PREDICTIONS FOR RADIATIVE DECAYS OF MESONS. Bramon, A.; Greco, M. (CNEN, Frascati, Italy). Phys. Lett.; 48B: No. 2, 137-140(21 Jan 1974).

From simple quark model arguments and assuming a quadratic $\eta - \eta'$ mixing the radiative decays of the vector and pseudoscalar mesons are predicted in good agreement with experiments. The results strongly favor the new determination of the $\eta \to \gamma\gamma$ partial width. (auth)

25334 ISOSPIN ANALYSIS OF THE REACTION $\bar{p}N \to NN\pi$ FROM THRESHOLD TO 2.90 GeV/c. Ming Ma, Z.; Mountz, J.; Zemany, P.; Smith, G. A. (Michigan State Univ., East Lansing). Nucl. Phys.; B68: No. 1, 214-220(1974).

An isospin analysis of single-pion production processes in antiproton-nucleon scattering from threshold to 2.90 GeV/c. Reactions used are $\bar{p}p \to \bar{p}p\pi^0$, $\bar{n}p\pi^-$ and $\bar{p}n \to \bar{p}p\pi^-$. Results show that σ_1, the total I = 1 cross section, rises rapidly from threshold to reach a broad maximum around 2.5 GeV/c and σ_0, the I = 0 cross section, rises from threshold and continued on a linearly rising trend at least up to 2.90 GeV/c. In the region of 2.9 GeV/c, σ_1 and σ_0 have comparable values, thus suggesting that considerable amount of I = ½ Nπ and Nπ states is produced even in this low momentum region. It is further determined that single pion production processes are not the source of the π_0 (2375, 190) enhancement observed in the $\bar{p}p$ and $\bar{p}d$ total cross sections and may account for as much as 25 ± 8% of the π_1 (2350, 140) enhancement. (auth)

25335 THEORY OF INTERACTING POMERONS. Migdal, A. A. (Inst. for Theoretical Physics, Moscow); Polyakov, A. M. Ter-Martirosyan, K. A. Phys. Lett.; 48B: No. 3, 239-242(4 Feb 1974).

The quantitative theory of Pomeron interaction is developed on the basis of strong-coupling methods and ϵ expansion. The theory is consistent with all unitarity conditions. At asymptotic energy total cross section increases as $(\ln s)^\eta$, the multiplicity as $(\ln s)^{\eta+1}$, and diffraction cone shrinks as $(\ln s)^{-\nu}$, where $\eta \approx 1/6$, $\nu \approx 13/12$. At modern energy the theory gives small corrections to the Regge model. (auth)

Strong (Baryon No. = 1)

25336 (JINR-P2-7600) S-WAVES OF THE πN SCATTERING AND THE VALUE OF THE SIGMA-COMMUTATOR IN THE STATIC MODEL. Gerdt, V. P.; Zhuravlev, V. I.; Meshcheryakov, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Within the static model a satisfactory description of the energy dependence of s-phases of the πN scattering up to 292 MeV was obtained. S-wave scattering lengths and the σ-commutator value are calculated. (auth)

25337 (LBL-948) K-MATRIX FITS TO $\pi N \rightarrow N\pi$ AND $N\pi\pi$ IN THE RESONANCE REGION $\sqrt{s} = 1.3$ TO 2.0 GeV. Longacre, R. S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1973. Contract W-7405-eng-48. 98p. Dep. NTIS $3.00.

Thesis.

Starting with partial wave amplitudes for $\pi N \rightarrow N\pi$ and $\pi N \rightarrow$ several isobar model states of $N\pi\pi$, one can apply the constraint of unitarity (using the K-matrix). This permits the removal of the overall phase ambiguity of the isobar amplitudes at each energy. The K-matrix fits generated a smooth prescription for the T-matrix amplitudes, enabling one to search the complex energy plane for poles. The uniqueness of these poles was demonstrated by doing Breit-Wigner refits to the fitted T-matrix amplitudes. The success of the refits and the obvious interpretation justified a simple determination of coupling signs for which there can be checks with theory. This thesis corresponds closely to a forthcoming paper submitted to Physical Review except that here the K-matrix is based on a 1972 solution "A" isobar-model fits to $N\pi\pi$ data, and in the final paper solution "B" is used. (auth)

25338 BOX DIAGRAM FOR THE PSEUDOSCALAR BOSONS AND SPIN-(1/2) FERMIONS OF ARBITRARY MASSES. Desmarais, J. (Département de Physique, Université de Montréal, Montréal, Québec, Canada); Brunet, R.C. Phys. Rev. D 8: No. 8, 2725-2728 (15 Oct 1973).

We generalize to the case of eight arbitrary masses results previously obtained for the box diagrams of pseudoscalar bosons (mass μ) interacting with spin-1/2 fermions (mass M). We calculate the absorptive parts in terms of simple analytic functions, enabling one to write the amplitudes as single-variable integrals. Substractionless dispersion relations are possible again with fixed s for either the direct or crossed box diagrams. Systematic checking of results was carried out with a computer program. (auth)

25339 ODORICO ZEROS FOR EXOTIC EXCHANGE PROCESSES. Singh, C. P. (Banaras Hindu Univ., India). J. Phys., A (London); 7: No. 1, L1-L3(1 Jan 1974).

On assuming that the exotic exchange reaction $\pi^- p \rightarrow \Sigma^- K^+$ occurs as a result of multiple non-exotic exchanges $\pi^- p \rightarrow \rho^0 n \rightarrow \Sigma^- K^+$, it is found that the imaginary parts of the invariant amplitudes A and B for the above reaction show Odorico zeros at almost fixed and small value of momentum transfer. The recent phase shift analysis of Langbein and Wagner (Nucl. Phys. (1973) in the press) supports this result. (auth)

25340 DUAL PARTON MODEL AND THE PROCESS $\pi N \rightarrow N\rho$ IN THE FORWARD AND BACKWARD REGIONS. Bandyopadhyay, P. (Indian Statistical Inst., Calcutta); Raychaudhuri, P.; De, S. S. Particles Nucl.; 6: No. 1, 32-43(Jul 1973).

On the basis of the dynamical dual model of strong interactions followed from the parton model of hadrons as discussed in an earlier paper, the process $\pi N \rightarrow N\rho$ is studied both in the forward and backward region. The differential cross section as well as the energy dependence is found to be in excellent agreement with experimental results. (auth)

25341 DUALITY ASPECTS OF MESON-BARYON SCATTERING AND URBARYON REARRANGEMENT AMPLITUDES. Awaya, K.; Kobayashi, A.; Ninomiya, K. (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto); 50: No. 2, 574-588(Aug 1973).

On the basis of the urbaryon rearrangement pictures, differential cross section and polarization of forward and backward two-body scattering are studied phenomenologically. It is shown in the forward region that the observed large polarization and the breaking of line reversal relation in differential cross sections are due to the existence of one of the Z-type urbaryon rearrangement amplitudes (Z_2) which has non-exotic SU(3) quantum number in all channels. In the backward region, a result is obtained that the Z_2 amplitude is suppressed remarkably compared with other urbaryon rearrangement amplitudes. Furthermore relative magnitude and phases among various urbaryon rearrangement amplitudes are obtained. Meanings of these results are discussed in connection with other theoretical frameworks, e.g., the absence rule, the duality, the Regge pole model and the SU(3) approaches. (auth)

25342 NEW TABULATION OF FORWARD PION-NUCLEON SCATTERING AMPLITUDES. Ferrari, E. (Univ., Rome). Rev. Brasil. Fis.; 2: No. 3, 225-298(Dec 1972).

Following an exhaustive discussion on the treatment of the errors affecting πN-scattering experimental data, a new tabulation of forward scattering amplitudes and total cross sections is presented. (auth)

25343 WILSON-ZIMMERMANN EXPANSIONS AND THE NORMAL PRODUCT ALGORITHM FOR THE WARD IDENTITY OF THE AXIAL-VECTOR CURRENT IN MESON-NUCLEON DYNAMICS. Schweda, M. (Technische Hochschule, Vienna). Nucl. Phys., B68: No. 2, 496-508(1974).

Zimmermann's normal-product algorithm is developed for the renormalizable γ_5 interaction of meson-nucleon dynamics. With the help of Zimmermann's algebraic identities Wilson's short-distance expansion and the Zimmermann identity are verified in perturbation theory for a fermion-fermion operator product. The power of this method is demonstrated in clarifying problems which seemed to appear in earlier, less rigorous, treatments of a generalized Ward-identity for the axial vector in such a field theory. (auth)

25344 OPTIMAL BOUNDS FOR REGGE-POLE PARAMETERS FROM LOW ENERGY DATA. Caprini, I. (Inst. for Atomic Physics, Bucharest). Nucl. Phys., B68: No. 2, 561-573(1974).

A method for determining high-energy parameters from low-energy data is described and applied to the πN forward charge-exchange amplitude A'^-. Unlike the usual FESR or CMSR which are based upon the Cauchy integral formula (dispersion relations) the present method uses the solution of an extremal problem in the space of analytic functions. This allows optimal bounds on Regge residues and correlations between Regge parameters and low-energy data to be derived in a completely independent way. (auth)

25345 ENERGY DEPENDENCE OF THE QUASI TWO-PARTICLE REACTION IN THE ONE-PARTICLE EXCHANGE MODEL. Golyak, I. G.; Gridneva, S. A.; Kosmachev, O. S.; Rus'kin, V. I. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 53-61(1973). (In Russian).

In the framework of the one-particle exchange model the stable interactions of η, ρ, and A_1 mesons with nucleons were evaluated. The energy dependence of the total cross sections of all possible quasi two-particle reactions in $\pi^\pm p$ interactions was obtained. (tr-auth)

25346 FACTORIZATION IN THE INCLUSIVE REACTIONS $\pi^\pm p \rightarrow \Lambda + X$ AND $K^- p \rightarrow \Lambda + X$. Paler, K. (Rutherford High Energy Lab., Chilton, Eng.); Shah, T. P.; Tovey, S. N. Phys. Lett.; 48B: No. 2, 151-154(21 Jan 1974).

A test is made of the factorization scheme proposed by Miettinen for the inclusive reactions $\pi^\pm p \rightarrow \Lambda + X$ at 18.5 GeV/c and $K^- p \rightarrow \Lambda + X$ at 14.3 GeV/c. The test is applied to the lambda differential cross section and polarization via a sum rule derived within the concepts of duality and exchange degeneracy, and SU_3. The original scheme is found not to agree with the experimental data. A possible explanation of the disagreement is discussed. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 25241, 25490, 25658, and 25681.

25347 DOES THE RISE IN THE TOTAL CROSS SECTION IMPLY A LARGE SHRINKAGE IN THE DIFFERENTIAL CROSS SECTIONS. Soln, J. (Harry Diamond Labs., Washington, DC). Lett. Nuovo Cim.; 9: No. 7, 281-283(16 Feb 1974).

Using the general features of the extended bremsstrahlung model, it is shown that the increase in the total pp cross section implies a significant shrinkage in the total pp differential cross section at least in some regions of -t (the square of the cm momentum transfer). It is conjectured that a similar shrinkage should also be experienced by the elastic pp differential cross section. (LBS)

25348 INFLUENCE OF ISOSPIN CONSERVATION ON PION MULTIPLICITY DISTRIBUTION INDEPENDENT EMISSION MODELS. Karczmarczuk, J.; Wosiek, J. (Jagiellonian Univ., Krakow). Acta Phys. Pol.; B5: No. 1, 105-114(1974).

Two models are discussed for multiple pion production in which strict conservation of isospin generates strong correlations in multiplicity distribution. The first model is a particular version of the uncorrelated jet model in which pions are produced in an eigenstate of total isospin and charge, the second one is the hadronic bremsstrahlung model of pion emission by an isospinor nucleon current. The predictions of these models concerning multiplicity distribution are almost identical: 1) linear rise of the dispersion of the negative pion multiplicity distribution with the average multiplicity which agrees with the data very well, and 2) strong negative correlations between charged and neutral pions which is in disagreement with the data. (auth)

25349 CORRECTIONS IN THE MULTIPLE SCATTERING IN SCATTERING TO A LOOSELY BOUND SCALAR STATE. Braun, M. A.; Kallis, V.; Senyushkin, V. B. Vestn. Leningrad. Univ., Fiz., Khim.; No. 3, 12-19(Aug 1973). (In Russian).

The scalar model of a low energy πD scattering within the limits of deuterons binding energy $\epsilon \to 0$ has been considered. The corrections to the impulse approximation due to the multiple scattering and production of a virtual meson are obtained. (auth)

25350 STUDY OF DUAL DIFFRACTIVE MODELS IN PROCESS $pp \to pn\pi^+$ AT 12 GeV/c. Kundrat, V.; Zralek, M. (Jagiellonian Univ., Krakow). Acta Phys. Pol.; B5: No. 1, 81-96(1974).

The Pokorski–Satz and the Dorren–Rittenberg–Yaffe models for diffractive process $pp \to pn\pi^+$ at 12 GeV/c are tested. The Dorren–Rittenberg–Yaffe model is tested with 0.0, 0.3, and 0.5 pomeron slopes. This model has only two free parameters (the overall normalization constant and relative coupling constant) and gives a reasonably good agreement with the data for the pomeron slope of 0.3 and 0.5. In particular, it gives the correct angular distributions in the Gottfried–Jackson angle on the $n\pi^+$ system. The distribution in azimuthal angle $\Phi(n\pi^+)$ in Gottfried–Jackson and helicity frames are not flat which means that helicity is not conserved either in t- or in s-channels. The Pokorski–Satz model also reasonably describes the data except for the angular distributions in the Gottfried–Jackson frame. (auth)

25351 PARITY VIOLATION IN POLARIZED p–p SCATTERING. Simonius, M. (Eidgenoessiche Technische Hochschule, Zurich). Nucl. Phys., A; A220: No. 2, 269-276(1974).

Predictions for parity violating amplitudes and polarization effects in p-p scattering due to 2π and vector meson exchange are discussed. Recent experimental results on parity violation in thermal n-p capture and other nuclear processes are taken into consideration. A possible source of error in the current interpretation of the parity violating α-decay of $^{16}O^*(2^-$, 8.87 MeV) is pointed out. (auth)

25352 LOW-ENERGY ELASTIC SCATTERING OF PIONS BY THE DEUTERON. Peresypkin, V. V.; Petrov, N. M. (Inst. for Theoretical Physics, Kharkov). Nucl. Phys.; A220: No. 2, 277-283(1974).

The problem of the elastic scattering of pions by a deuteron is considered using the separable representation of the two-body t-matrix. The Faddeev equations are reduced to a set of one-dimensional integral equations by separating the angular variables. The dependence of the π-d scattering length on the form of two-body interaction and on the values of the π-N scattering lengths is studied in the case of a one-term nonlocal potential with separable variables. The π-d scattering length proves to be practically independent of the two-body interaction form, and is essentially dependent on the values of the π-N scattering lengths. (auth)

25353 SUM RULES FOR POTENTIAL SCATTERING. Takibaev, N. Zh. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 15-20(1973). (In Russian).

By use of the analytical properties of the Jost function on the complex wave number, sum rules connecting the energy of the discrete spectrum level with the displacement of the elastic scattering phase with physical values of the wave number were obtained for a wide class of potentials. It was shown that the sum rules satisfactorily describe the neutron-proton scattering and Breit–Wigner resonances. (tr-auth)

25354 POSITIVE $\pi-\pi^0$ CORRELATION IN AN UNCORRELATED JET MODEL. Reinders, L. J.; Ruijgrok, T. W.; Schlitt, D. W. (Univ., Utrecht). Acta Phys. Pol.; B5: No. 1, 135-142(1974).

Any uncorrelated jet model is characterized by the three distributions $P_0(n)$, $P_1(n)$ and $P_2(n)$ for the total number of pions in the final mesonic states with isospin 0, 1 and 2. It is shown that for each number of protons in the final state there exists a scaling function for the total number of charged particles. In pp-collisions there are three such functions (when pair production is disregarded). A measurement of these three functions would be very important since they completely determine every other distribution and therefore all correlations. It is shown that positive $\pi^- - \pi^0$ correlations can be obtained from three Poisson-distributions $P_0(n)$, $P_1(n)$ and $P_2(n)$, provided their averages $\overline{N}_0$, $\overline{N}_1$ and $\overline{N}_2$ are not equal. This effect is similar to that of the two-component model. (auth)

25355 BREMSSTRAHLUNG IN NUCLEON–NUCLEON COLLISIONS. Nyman, E. M. (Nordita, Copenhagen). Phys. Rep.; 9C: No. 3, 179-198(Feb 1974).

The theory of bremsstrahlung in nucleon–nucleon collisions at non-relativistic energies is reviewed, with special emphasis on the possibility of drawing conclusions concerning the nucleon–nucleon interaction. The basic concepts are introduced and illustrated for the case of a separable interaction. Soft-photon theorems are discussed. Some brief comments are given on the comparison between theory and experiment. The theory needs a number of correction terms, which are discussed. A generalized Ward identity for bremsstrahlung, which relates the divergence of the contribution from internal lines to off-shell scattering amplitudes is also given. (auth)

25356 TEST FOR T-VIOLATING IN N–N SCATTERING. Binstock, J. (Texas A and M Univ., College Station); Bryan, R.; Gersten, A. Phys. Lett.; 48B: No. 2, 77-80(21 Jan 1974).

Predictions are made for the angular distributions of nucleon–nucleon observables revealing T-violation, in the limit of very short-ranged T-violating mechanisms. Curves are shown for the observables $P - a$, and $P_A - P_B$, at 425 MeV for both p-p and n-p scattering. (auth)

25357 RECONSTRUCTION OF N-PARTICLE TOTAL CROSS SECTIONS FROM N-PRONG TOTAL CROSS SECTIONS IN pp COLLISIONS. Froeyland, J.; Skontorp, O. (Univ. of Oslo). Nucl. Phys.; B68: No. 1, 93-110(1974).

By using strong smoothness requirements total n-particle cross sections were constructed from observed n-prong total cross sections from 4 to 303 GeV/c in pp collisions. Weights of the final multiparticle states are assumed to be given by statistical weights multiplied by a Gaussian. The reconstructed values for various special channels are satisfactory, and the agreement with measured average numbers of π^+, π^0 and π^- is very good. The same is true for the average number of π^0 for given prong numbers. The average $\langle n \rangle$ has an energy dependence very close to that of $\langle n_{ch} \rangle$. The energy dependence of the lowest multiplicities shows no sign of leveling off thus indicating absence of diffraction dissociation. The ratio $\langle n \rangle / D$ is very close to two in the whole energy range. The Koba–Nielsen–Olesen scaling holds within the errors from 10 to 303 GeV/c. (auth)

25358 $pp\pi^0$ COUPLING CONSTANT AND ELECTROMAGNETIC EFFECTS IN p–p FORWARD DISPERSION RELATIONS. Viollier, R. D.; Plattner, G. R.; Alder, K. (Univ. of Basel). Phys. Lett.; 48B: No. 2, 99-101(21 Jan 1974).

It is shown that a "Coulomb-renormalized" $pp\pi^0$ coupling constant can be defined and deduced from experiment by applying a forward dispersion relation to Coulomb-modified p-p scattering amplitudes. The value determined in this model-independent way from the Livermore phase shifts is $G^2_{pp\pi^0} = 15.3 \pm 0.3$. (auth)

25359 $p + p \to p + X$ REACTION AT LARGE TRANSVERSE MOMENTUM IN THE FRAGMENTATION REGION AND THE GLUON EXCHANGE PARTON MODEL. Patkos, A. (Roland Eotvos Univ., Budapest). Phys. Lett.; 48B: No. 2, 128-132(21 Jan 1974).

In case of the $p + p \to p + X$ reaction the kinematical region is considered where the detected proton with large transverse momentum is scattered quasielastically. The single proton distribution and the asymmetry of the charged products with large opposite transverse momenta have been investigated. (auth)

25360 INCLUSIVE SPECTRA IN THE REACTIONS $np \to \pi^{\pm}X$ AND $np \to pX$ IN THE ENERGY RANGE 2 TO 10 GeV. Gasparyan, A. P.; Kopylova, D. K.; Nikitin, A. V.; Rodionov, A. I.; Troyan, Yu. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 1, 93-102(Jan 1974). (In Russian).

Inclusive processes $np \to \pi^{\pm}X$ and $np \to pX$ are investigated in the neutron energy range 2 to 10 GeV. Dependences of the structure function f on x, $p^2_\perp$, s are studied and the approximations are obtained. (auth)

25361 NECESSITY OF POLARIZATION EXPERIMENTS IN COLLIDING pp AND $\bar{p}p$ BEAMS. Kopeliovich, B. Z.; Lapidus, L. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 1, 218-223(Jan 1974). (In Russian).

In view of the results on total pp interaction cross sections measured at ISR a possibility is considered of direct investigation of the spin-dependent part of the pp-scattering amplitude. The necessary information may be obtained measuring the contribution from the interference of the electromagnetic and hadronic amplitudes to the polarization at small scattering angles. In case of absence of the spin dependence in the hadronic amplitude the maximal polarization amounts to 4.5%. A measurement of components of the correlation polarization tensor is also useful. (auth)

25362 DEVIATION FROM SCALING IN THE TRIPLE-REGGE REGION OF pp → pX AND f/P UNIVERSALITY. Balazs, L. A. P. (Purdue Univ., Lafayette, IN). Phys. Lett.; 48B: No. 3, 232-234 (4 Feb 1974).

By generalizing f/P universality to Regge-particle "scattering," $s\,d\sigma/dt\,dM^2 = F(s/M^2,t)[1 + M^{-1}\,b_f(0)/b_P(0)]$ is obtained for pp → pX, where $b_f(t)$ and $b_P(t)$ are the f and P Regge residues for, say, pp → pp. This agrees with the recent NAL data. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 25300, 25385, and 25917.

25363 CHIRAL SYMMETRY LIMIT IN THE SU(3) σ MODEL WITH BILINEAR BREAKING. McKay, D.W. (University of Kansas, Lawrence, Kansas 66044); Palmer, W.F.; Sarraga, R.F. Phys. Rev. D 8: No. 8, 2532-2545 (15 Oct 1973).

We add to the usual σ model a $(3^*, 3) + (3, 3^*)$ term which is bilinear in the scalar-meson fields and study the behavior of the tree-approximation solutions as the explicit symmetry breaking is turned off. We find that both $c \simeq -\sqrt{2}$ and $c \simeq 0$ occur for the same mass spectrum, 0–8 mixing, and F_K/F_π. Solutions with different c values approach the symmetry limit differently, but in this limit one can smoothly reach either a Goldstone pseudoscalar octet, or a symmetric vacuum, or neither for both values of c. No clear indication is found that solutions are near a critical value of the mass parameter. (auth)

25364 ANALYTIC REPRESENTATIONS OF THE CONFORMAL GROUP IN FOUR AND FIVE DIMENSIONS CONNECTED WITH DIFFERENTIAL EQUATIONS. Muggli, J. (Inst. of Theoretical Physics, Kiev). Helv. Phys. Acta; 46: No. 2, 253-272 (15 Aug 1973).

The conformal group C_d is represented by analytic spinor representations in the complex symmetric domain corresponding to the group. In four dimensions for every spin there exists one irreducible representation solving invariantly a wave equation, and thus describing a massless particle. For massive particles nonlinear differential equations in five dimensions with the proper time as fifth coordinate are found which are covariant under the conformal group C_5 and invariant under the invariance group for massive particles $G \subset C_5$ containing the Poincaré group P(4), dilatation, and proper time translation. The most simple system of equations is tentatively ascribed to the electron–positron system connected with electromagnetic and gravitational fields. The Lorentz group L(4) can be extended by adding Lie elements from C_5 to the direct product of L(4) and SO(2,1), probably connected with isospin. (auth)

25365 SYMPLECTIC GROUP AND PARITY. Schiff, H. (Univ. of Alberta, Edmonton). Lett. Nuovo Cim.; 9: No. 6, 242-244(9 Feb 1974).

It is shown that the discrete operator of space inversion is an element of the continuous sympletic group. (LBS)

25366 REDUCTION U(nm)↓U(n)XU(m). Mickelsson, J. (Univ. of Goteborg). Rep. Math. Phys.; 4: No. 1, 77-83(Mar 1973).

A complete set of cperators is constructed connecting different vectors of maximal weight with respect to the subgroup U(n) XU(m) ⊂ U(nm), in an irreducible representation space of the group U(nm). These operators, together with the canonical lowering operators, can be used to construct a complete basis compatible with the reduction U(nm)↓U(n)XU(m). (auth)

25367 GENERALIZED DUAL AMPLITUDES AND REPRESENTATIONS OF CLASSICAL GROUPS BY THE FUNCTIONS OF SEVERAL COMPLEX VARIABLES. Manida, S. N.; Franke, V. A. Vestn. Leningrad. Univ., Fiz., Khim.; No. 3, 7-11(Aug 1973): (In Russian).

Generalizations of the symmetric dual model are constructed on the basis of the complex spaces. A classical Lie group is taken as a group of symmetry. Physical amplitudes are constructed in the case of SU (N, 1) group. (auth)

25368 CONFORMAL INVARIANCE AND ABNORMAL DIMENSIONALITIES. Konopel'chenko, B. G.; Pal'chik, M. Ya. (Inst. of Atoms and Electrons, Moscow). Yadern. Fiz.; 19: No. 1, 203-214(Jan 1974). (In Russian).

Conformal invariant field theory in two-dimensional and four-dimensional space-times is considered. It is shown that one has to consider not the conformal group as the group of conformal symmetry, but its universal covering that have besides the one- and two-valued representations of the conformal group, also its infinite-valued representations. If one confines oneself to the one- and two-valued representations, the conformal invariance is compatible with axioms of the field theory only in case of the fields with discrete dimensionality $d = N/2 + s + n$, where N is dimension of the space-time, S is the spin, and $n = 0, 1, 2, \ldots$. Irreducible representations of the two-dimensional conformal group are considered in detail. The Thirring model is discussed. It is shown that in this model the fields are transformed according to the infinite-dimensional representations of the discrete series. (auth)

25369 STRUCTURE OF ANOMALIES FOR ARBITRARY DIMENSION OF THE SPACE–TIME. Grimm, R.; Marculescu, S. (Univ., Karlsruhe, Ger.). Nucl. Phys.; B68: No. 1, 203-213(1974).

The construction of anomalies in Ward identities is investigated for arbitrary dimension of the space-time. If the internal symmetry group is semi-simple and compact it is found that for even dimension of the space-time the anomalous term is unique and that no anomaly is constructible for odd dimension. (auth)

25370 GENERALIZED DIRAC CURRENT IN O(4,2) THEORY. Wilson, R. (Stevens Inst. of Tech., Hoboken, NJ). Nucl. Phys.; B68: No. 1, 157-176(1974).

A relativistic Lagrangian field theory of spin-half particles using a four-dimensional Dirac-representation of O(4,2) is considered. In this theory a generalized Dirac current with a "convective" term is used. From the field equation a point-quantum mechanical Hamiltonian is derived and certain integrated quantities are investigated. A general divergence term that can be added to a free Lagrangian density without changing the corresponding field equation is suggested and illustrated. The scale invariance of the theory is examined. Also the theory is second-quantized and is studied in the infinite momentum limit. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 25233, 25330, and 25936.

25371 CONSERVED CURRENTS, THEIR COMMUTATORS AND THE SYMMETRY STRUCTURE OF RENORMALIZABLE THEORIES OF ELECTROMAGNETIC, WEAK, AND STRONG INTERACTIONS. Weinstein, M. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. D 8: No. 8, 2511-2524 (15 Oct 1973).

This paper discusses the role played by conserved currents in fixing the structure of currently popular renormalizable theories of strong, electromagnetic, and weak interactions. The major objective of this work is to show that these theories correspond to another kind of symmetry —which we call a Higgs-type symmetry—and to clarify the relation of this scheme to the already familiar normal and Goldstone symmetries. In order to do this, we introduce a language which makes no reference to any specific Lagrangian formalism and so avoids questions of whether or not hadrons are composite and whether or not the Goldstone bosons (massless particles of these theories) necessarily have massive partners. For pedagogical reasons, we discuss the original Weinberg model of leptons and a model coupling leptons and hadrons from the current-algebra point of view. (auth)

25372 SCHWINGER TERMS AND THE LIGHT-CONE EXPANSION. Gomberoff, L.; Horwitz, L.P. (Department of Physics and Astronomy, Tel-Aviv University, Ramat Aviv, Israel). Phys. Rev. D 8: No. 8, 2578-2583 (15 Oct 1973).

A singularity on the light cone is conjectured which accounts for the Schwinger term required for the consistency of the Lee-Dashen-Gell-Mann sum rule with that of Cabibbo and Radicati. This singularity requires W_3 to scale, rather than (as conventionally assumed) νW_3; because of positivity constraints, such behavior forbids in principle the usual scaling law for W_1 and νW_2. (auth)

25373 CONSTRAINTS ON HIGGS FIELDS IN UNIFIED WEAK-ELECTROMAGNETIC GAUGE THEORIES. Lieberman, J. (Rockefeller University, New York, New York 10021). Phys. Rev. D 8: No. 8, 2545-2552 (15 Oct 1973).

In renormalizable unified gauge theories of the weak and electromagnetic interactions, for a given gauge group we ask the following question: Which representations of the scalar Higgs particles can reproduce a vector-meson mass spectrum in which one vector meson, the photon, remains massless and all other vector mesons acquire mass? Given the Higgs representation, we then examine what restrictions are placed on the charge operator of the theory. The examples of SU(3) and SU(3) × U(1) are worked out in detail. The possible Higgs representations for all the unexceptional classical Lie groups are given. For each such group, there are some low-dimensional representations for which no solution exists. (auth)

25374 PARITY VIOLATION IN ATOMS IN SO(3) GAUGE MODELS. Piketty, C. A. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nucl. Phys.; B68: No. 1, 44-65(1974).

The parity-violation contribution in atoms was calculated in the framework of SO(3) gauge theory. Various hadronic models were used: first, for simplicity, the unrealistic five-quark one, next, others involving three ordinary SU(3) triplets for which all unwanted strangeness-changing processes are suppressed, up to order $G\alpha$ or $G\alpha\Delta M^2/M^2_w$. In the free quark approximation, quite similar parity-violation effects were obtained which are proportional to $G\alpha\Delta M^2/M^2_w$ (ΔM^2 is the difference of squared masses of leptons ($M^2_{x_e} - M^2_{\nu} = M^2_{x_e}$), or of quarks ($\Delta M^2_q$)). Namely, in large atoms ($Z \gg 1$) the electronic contribution which is proportional to $G\alpha(M^2_{x_e}/M^2_w)Z(\sigma_l \cdot p_l/m_l)$ gives the largest effect (σ_l, p_l and m_l are the spin, momentum operators and mass of the lepton). Parity-violating effects in SO(3) gauge models are $\approx 10^{-4}$ smaller than those evaluated in the Weinberg theory with a neutral parity-violating current and will remain undetectable in the near future. (auth)

25375 PSEUDO-GOLDSTONE BOSON MASSES IN A ONE-LOOP APPROXIMATION. Lee, S. Y.; Rawls, J. M.; Yu, L. P. (Univ. of California, San Diego, La Jolla). Nucl. Phys.; B68: No. 1, 255-269(1974).

A one-loop calculation of pseudo-Goldstone boson masses in a spontaneously broken gauge model indicates that they are either identically zero or too large (of the order of several GeV) to be identified with the pion masses. The former possibility, which suggests that the pion mass may have its origin in even higher order weak and electromagnetic corrections, is investigated. (auth)

Applications (Strong)

Refer also to abstracts 25356 and 25920.

25376 DUAL MODELS AND SPONTANEOUS SYMMETRY BREAKING. Bardakci, K. (Univ. of California, Berkeley). Nucl. Phys., B68: No. 2, 331-348(1974).

The question of spontaneous symmetry breaking in dual models is investigated. In the context of a particular model with a conserved "charge", two different approaches to the problem, spurion emission and the effective potential methods, are developed. A method is described for the calculation of the effective potential, and it is applied to determine the first few terms of the potential. (auth)

25377 SOME FEATURES OF SU(4) SYMMETRY. Mubarak Ahmed. (Univ. of Kashmir, India). Czech. J. Phys.; 24: No. 1, 24-31(1974).

Representations and generators for SU(4) symmetry are obtained. SU(3) content of SU(4) is derived. A general formula for the c.c. series of the direct product of two representations of SU(4) symmetry is obtained. (auth)

Scattering Theory

Refer also to abstracts 25338, 25367, 25636, and 25924.

25378 (KFKI-73-69) NUMERICAL SOLUTION OF THE PROBLEM OF SCATTERING ON A CLASS OF SINGULAR POTENTIALS. Dolinszky, T. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1971. 7p. Dep. NTIS (U. S. Sales Only) $3.00.

The method and main results of the numerical integration of the differential equations for the nonrelativistic scattering on some singular potentials of the singularity r^{-4} are presented. Thereby a clear-cut decision was obtained as to the validity of the available analytical approximations for high energies. (auth)

25379 CORRELATION CHAINS AND POMERANCHUKON CUTS. Botke, J.C. (Department of Physics, University of California, Santa Barbara, California 93106). Phys. Rev. D 8: No. 8, 2594-2600 (15 Oct 1973).

A general decomposition of the unitarity phase space is discussed which leads naturally to the concept of a correlation chain. It is shown that single- and multiple-chain contributions to the n-body production amplitude result in, respectively, planar and nonplanar contributions to the unitarity sum. Further, it is shown that these contributions are physically distinguishable. Experimental tests, based on two-particle correlations, are proposed and a direct connection is made with the two-Pomeranchukon cut. (auth)

25380 ISOLATING THE TWO-REGGEON CUT: AN S-MATRIX APPROACH. Botke, J.C. (Department of Physics, University of California, Santa Barbara, California 93106). Phys. Rev. D 8: No. 8, 2584-2593 (15 Oct 1973).

By separating the n particles of the full unitarity phase space into two bunches, the complete two-Reggeon contribution to the total cross section is identified. It is shown that the phase space divides into three regions characterized by forward coherent, backward coherent, and incoherent production of the two bunches and that the leading pole is generated at the boundaries between these regions. Further, while the sign of the cut contributions from the coherent regions is positive, that of the incoherent region is quite likely negative, which, for instance, negates multiperipheral arguments concerning the sign since such models include only the coherent regions of phase space. Constraints are obtained on the leading Pomeranchukon and first-order Pomeranchukon cut contributions to the forward particle-Pomeranchukon amplitude; namely, that the former must have a linear zero for vanishing external Pomeranchukon mass, and the latter an inverse logarithmic zero. Finally, it is shown that the Finkelstein-Kajantie troubles are a result of an improper treatment of the Pomeranchukon renormalization. (auth)

25381 GENERALIZED OPTICAL THEOREMS AND STEINMANN RELATIONS. Cahill, K.E. (Department of Physics, Wesleyan University, Middletown, Connecticut 06457); Stapp, H.P. Phys. Rev. D 8: No. 8, 2714-2720 (15 Oct 1973).

Generalized optical theorems and generalized Steinmann relations for 3 → 3 processes are described. These results follow from the field-theoretic formalism of Bros, Epstein, and Glaser. The theorems express in terms of physical-region scattering functions the discontinuity of any 3 → 3 scattering function across any basic cut, which is a channel-energy cut that runs from the lowest normal threshold to plus infinity. Previously these discontinuities had been expressed, in general, only in terms of the analytic continuations of scattering functions. A remarkable property is found: The discontinuities have the algebraic structure they would have if the basic cuts were cuts in independent variables. Moreover, a generalized version of the Steinmann relations holds: The double discontinuity across any pair of independently treated crossed basic cuts vanishes. The original Steinmann relations have a much narrower scope. The generalized Steinmann relations are used to express compactly in terms of physical-region scattering functions any single, double, or higher-order multiple discontinuity of any 3 → 3 scattering function across any combination of basic cuts, evaluated on any specified side of each of the remaining basic cuts. All these basic discontinuities are expected to enjoy Regge asymptotic behavior. Although only basic cuts are mentioned, there is no neglect of the effects of other cuts. (auth)

25382 HELICITY POLES IN FIVE DIMENSIONS. Moen, I.O.; Zakrzewski, W.J. (Department of Applied Mathematics and Theoretical Physics, University of Cambridge, England). Phys. Rev. D 8: No. 8, 2613-2622 (15 Oct 1973).

The Regge contribution to the six-particle amplitude is studied by going to five dimensions and considering a generalization of the usual helicity approach. This has the advantages that the Steinmann relations are satisfied in a natural way, and that there are no spurious poles. The resulting representation can also be used to study more general limits than the usual multi-Regge limit. In particular, limits relevant to the two-particle inclusive cross section can be studied. The constraints imposed on this representation by Regge factorization are also considered. (auth)

25383 POTENTIAL SCATTERING IN THE EIKONAL APPROXIMATION. Byron, F.W. Jr (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002); Joachain, C.J.; Mund, E.H. Phys. Rev. D 8: No. 8, 2622-2639 (15 Oct 1973).

A systematic study is made of the limits of validity of the eikonal approximation in nonrelativistic potential scattering theory. We suggest that for a large class of potentials, and for all momentum transfers, each term of the eikonal multiple-scattering series gives the asymptotic value (for large incident wave numbers) of the corresponding term in the Born series. This property, together with the requirement of unitarity, implies that in weak-coupling situations the eikonal approximation, is consistently worse than the second Born approximation. For intermediate couplings we find that the eikonal method is remarkably good at all angles for potentials of the Yukawa type. For the case of strong coupling ($|V_0| > E$) we find that for all potentials studied there is good agreement between exact and eikonal results at small angles. Analytical and numerical results are given for a variety of interaction potentials. (auth)

25384 EIKONAL CONSTRUCTION WITH RADIATIVE CORRECTIONS. Kirby, B.J.; Fried, H.M. (Department of Physics, Brown University, Providence, Rhode Island). Phys. Rev. D 8: No. 8, 2668-2674 (15 Oct 1973).

A form of eikonal construction is suggested in which external, multiplicative form factors and internal, Chou-Yang-type form-factor dependence both appear simultaneously. When extended to absorptive scattering situations, one may expect a graying of the equivalent black disk. (auth)

25385 TWO-VARIABLE GALILEI-GROUP EXPANSIONS OF NONRELATIVISTIC SCATTERING AMPLITUDES. Kalnins, E.G.; Patera, J. (Centre de Recherches Mathématiques, Université de Montréal, Case Postale 6128, Montréal, P. Q., Canada); Sharp, R.T.; Winternitz, P. Phys. Rev. D 8: No. 8, 2552-2572 (15 Oct 1973).

Two-variable Galilei-group expansions are derived for the two-particle nonrelativistic scattering amplitude. These expansions contain the usual partial-wave and eikonal expansions and supplement them by further expansions in the remaining kinematic variable. The expansions are written both for square-integrable and for asymptotically increasing amplitudes and are shown to correspond to the nonrelativistic limit of previously considered relativistic two-variable expansions. Dynamical singularities (Breit-Wigner resonances, bound states, poles in the impact-parameter plane, etc.) are investigated and related to the asymptotic behavior of the expansion coefficients (or Galilei amplitudes). The threshold and high-energy limits of the expansions are discussed. As a mathematical by-product we give a classification of the subgroups of E(3) and also some results on the representation theory of this group; in particular we study the Clebsch-Gordan coefficients. (auth)

25386 COMPLEX HELICITY PLANE. Brower, R.C. (Physics Department, California Institute of Technology, Pasadena, California 91109); Einhorn, M.B.; Green, M.B.; Patrascioiu, A.; Weis, J.H. Phys. Rev. D 8: No. 8, 2524-2532 (15 Oct 1973).

We argue that the locations of poles in complex helicity are determined completely by the Regge poles in complex angular momentum. They lie at "sense" values of the helicity, $m = \alpha_i, \alpha_i - 1, \alpha_i - 2, \ldots$, relative to the angular momentum singularities at $j = \alpha_i$. Thus, through the determination of helicity singularities, singularities in angular momentum determine asymptotic limits in addition to the conventional multi-Regge limits. (auth)

25387 A TRANSFORM TO CALCULATE SCATTERING AMPLITUDES. Rosenthal, C.M. (University of Bradford, Bradford, Yorkshire, England). Phys. Rev. A 9: No. 1, 273-282 (Jan 1974).

A line-integral representation for a transform of the free-particle Green's function is derived. This representation gives rise to a line-integral equation for the Yukawa-potential scattering amplitude. The second term in the Born series is recovered by iterating the equation once. Generalization to superpositions of Yukawa potentials and angular-dependent potentials is discussed. (auth)

25388 FIVE-PARTICLE AMPLITUDES NEAR PHYSICAL REGIONS. Berceanu, S.; Gheorghe, A.; Mihul, E. (Joint Inst. for Nuclear Research, Dubna, USSR). Lett. Nuovo Cim.; 9: No. 6, 245-250(9 Feb 1974).

For the hadronic reaction $a_4 + a_5 \rightarrow a_1 + a_2 + a_3$ the problem of finding the region of all the physical points where the scattering amplitude is the boundary value of a single analytic function on the mass shell is studied. The problem is illustrated for the reaction $p + p \rightarrow p + p + \pi^0$. (LBS)

25389 SEMICLASSICAL SCATTERING OF RIGID SPHERES. Siska, P. E. (Univ. of Pittsburgh). J. Chem. Phys.; 59: No. 6, 3429-3430(15 Sep 1973).

It is pointed out that a completely semiclassical treatment for the collisions of impenetrable or rigid spheres, while giving the same limit as $K \rightarrow \infty$, cannot yield the correct expansion. (JFP)

25390 PHASE FUNCTION METHOD FOR REACTIONS WITH PARTICLE REARRANGEMENT. Amirkhanov, I. V.; Grechko, V. E.; Dement'ev, R. K. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 5, 534-540(1973). (In Russian).

Within the framework of the multichannel coupling method partial scattering amplitudes for reactions with particle rearrangement and reactions above the breakdown threshold, a system of equations was obtained which are analogs of the known phase equations. Similar equations were described for the complete scattering amplitudes. The equation of quasipotential approach was used by two-body problems. Relativistic phase equations were obtained. (tr-auth)

25391 CONDITION OF CAUSALITY IN SCATTERING THEORY. Slavnov, D. A. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 5, 577-583(1973). (In Russian).

Within the framework of the scattering theory the principles of causality in the quantum field theory were formulated. The causality principles were stated in physical terms and occur both in relativistic and nonrelativistic theories. (tr-auth)

25392 FEYNMAN AMPLITUDES AS POWER SERIES. Kershaw, D. S. (Univ. of Maryland, College Park). Phys. Rev., D; 8: No. 8, 2708-2713(15 Oct 1973).

It is shown that single-loop Feynman integrals have a simple, natural expression as generalized hypergeometric power series. It is shown how to continue these power series to regions of physical interest and how to use them to derive simple systems of differential equations satisfied by single-loop Feynman integrals. Applications to the evaluation of the box-graph contribution to the scattering of light by light are discussed. (auth)

25393 ABSORPTIVE PARTS AND DOUBLE SPECTRAL FUNCTIONS ASSOCIATED WITH DUAL AMPLITUDES. Arik, M.; Coon, D. D. (Univ. of Pittsburgh). Phys. Lett.; 48B: No. 2, 141-144(21 Jan 1974).

A phenomenologically successful dual amplitude with logarithmic trajectories is studied. The delta function imaginary parts of the amplitude are approximated by an "averaged" imaginary part. As expected, the resulting averaged s-channel discontinuity vanishes when $\alpha(t) = 0, -1, -2, \ldots$ and also gives rise to a double spectral function with a correct hyperbolic boundary. It is argued that the dual amplitude has properties which are very similar to those expected from a composite particle model. (auth)

25394 REGGE-CUT DISCONTINUITY EQUATIONS AND SELF-CONSISTENT SOLUTIONS FOR MULTI-POMERON CUTS. Collins, P. A.; Williams, R. M. (Imperial Coll. of Science and Tech., London). Nucl. Phys.; B68: No. 1, 85-92(1974).

Using the results on the n-reggeon cut obtained by Gribov, Pomeranchuk and Ter-Martirosyan, formal solutions are constructed for a two-particle scattering amplitude involving the exchange of a pomeron and multi-pomeron cuts. (auth)

25395 EQUIVALENCE OF THE (0.1) MODEL OF SCHWARZ AND THE $\alpha(0) = -1$ MODEL OF GERVAIS AND NEVEU. Polane, J. H. (Vrije Universiteit, Brussel). Nucl. Phys.; B68: No. 1, 270-276(1974).

Using complete induction it is proved that the $\alpha(0) = -1$ model of Gervais and Neveu and the (0,1) model of Schwarz are equivalent. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

25396 MOTIONS IN A BOSE CONDENSATE. 3. The Structure and Effective Masses of Charged and Uncharged Impurities. Grant, J.; Roberts, P. H. (Univ., Newcastle-upon-Tyne, Eng.). J. Phys., A (London); 7: No. 2, 260-279(21 Jan 1974).

On the assumption that the radius b of an uncharged hard impurity (^{3}He) in an imperfect Bose gas is large compared with the healing length a, it is shown that its effective (hydrodynamic) radius b_{eff} is b + a/2. It is also shown that, correct to the first two orders in the expansion in powers of a/b, its effective (hydrodynamic) mass is $2/3\pi\rho b_{eff}^3$, where ρ is the fluid density. The modifications to these results required when the impurity is charged (as for $^4He_2^+$) are derived. The results are exact within the framework of the theory, and are obtained analytically. Comparisons with the numerical integrations of Padmore and Fetter (Ann. Phys. NY. 62: 293-319 (1971)) are made. The structure of the electron bubble is examined with a theory which treats $\epsilon = (a\mu/1M)^{1/4}$ as small (and μ/M as negligible), where μ is the electron mass, M the boson mass, and 1 is the electron–boson scattering length. To leading order, the radius of the bubble is shown to be $b = (\pi M^2a^2/\mu\rho)^{1/4}$, and the electron energy is found to be $h^2/8\mu b^2$. The corrections required at the next order in the a/b expansion are given, and it is shown that, even when polarization effects are negligible, b_{eff} is less than b. The effective mass is still, however, closely $2/3\pi\rho b_{eff}^3$, although motion tends to expand the bubble and make it oblate; the elipticity is evaluated. When polarization effects are included, the radius of the bubble is reduced by about 0.3 healing lengths. Comparisons are made with the numerical calculations of Clark (Phys. Lett.; 16: 42-3 (1965) and Superfluid Helium (1966)). (auth)

25397 GRAVITY INDUCED VORTICES AND STEPWISE GROWTH OF THESE VORTICES IN VERTICAL COUNTER-FLOW OF LIQUID HELIUM. Desrumaux, J. M.; Le Ray, M. (Centre Universitaire de Valenciennes, France). Phys. Lett., 46A: No. 4, 251-252(31 Dec 1973).

Detailed measurements of the second sound excess attenuation in vertical counterflow show the existence of a zero critical velocity and of steps which can be interpreted as a Josephson ac effect related to vortex motion. (auth)

25398 OPTICAL OBSERVATIONS OF SECOND SOUND RESONANCES IN HELIUM II. Mota, A. C.; Olsen, J. L.; Sorbello, R. S.; Tomar, V. S. (Eidgenoessische Technische Hochschule, Zurich). Phys. Lett., 46A: No. 5, 343-344(14 Jan 1974).

The resonance frequencies of second sound excited in a cylindrical cavity by axial heating are observed optically. The frequency distribution is compared with that resulting from Rayleigh's solution for sound waves in a similar geometry. (auth)

25399 THERMODYNAMIC EVALUATION OF THE CUBIC TERM IN THE PHONON SPECTRUM OF SUPERFLUID HELIUM. Zasada, C.S.; Pathria, R.K. (Department of Physics, University of Waterloo, Waterloo, Ontario, Canada). Phys. Rev. A 9: No. 1, 560-564 (Jan 1974).

When the approximation of overlapping momenta, in calculating the phonon and roton contributions to the thermodynamic properties of liquid helium II, is removed and the resulting expression for the specific heat of the system is fitted to experimental data at low temperatures, seemingly improved values of the phonon dispersion coefficient γ are obtained. At saturated vapor pressure, γ turns out to be -5.6×10^{37} cgs units, which is in excellent agreement with the value resulting from x–ray–scattering measurements. Comparison with neutron–scattering data suggests that γ may be strongly temperature dependent. (auth)

25400 HIGH-FIELD NEGATIVE-ION PERSISTENCE CURRENTS IN SUPERFLUID HELIUM. Little, R.E.; Liu, Y. (School of Physics, Georgia Institute of Technology, Atlanta, Georgia 30332). Phys. Rev. A 9: No. 1, 460-465 (Jan 1974).

The behavior of negative ions in superfluid helium at high electric fields has been investigated. It is concluded that at sufficiently high fields the negative-ion complex is not an electron trapped on a circular, singly quantized vortex ring. The size of the complex is measured and found to be about 35 μm. The ion complex is observed to break up at very high fields. (auth)

25401 NEW ARGUMENTS CONCERNING THE EFFECTIVE ^{3}He QUASIPARTICLE INTERACTION IN SUPERFLUID ^{4}He. Massey, W. E.; Yim, M. B. (Brown Univ., Providence). Phys. Rev., A; 8: No. 5, 2741-2743(Nov 1973).

By using the Woo–Tan–Massey theory of ^{3}He–^{4}He solutions, an expression is derived for V_0, the long-wavelength limit of the effective ^{3}He quasiparticle interaction in dilute ^{3}He–^{4}He solutions. The expression supports the calculation of Eckstein, Eckstein, Kuper, and Ron, and indicates that the Baym, Bardeen, Pines result for V_0 is incorrect. Arguments are also given to suggest that V_0 may be positive definite at all pressures. (auth)

Superconductivity

Refer also to abstracts 24578 and 24711.

25402 (AD-764905-6) ANOMALOUS TUNNELING CHARACTERISTICS. Frommer, M. H.; MacVicar, M. L. A.; Rose, R. M. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Metallurgy and Materials Science). 14 Aug 1973. Contract N–00014-67-A-0204-0041. 14p. NTIS $3.00.

Quasiparticle tunneling into superconducting transition metals often shows current-voltage characteristics differing from the ideal curves: there being an excess current peak or "knee" occurring at biases near the sum of the half energy gaps of the two superconducting electrodes. In the present work evidence is given that this knee is probably caused by excess adsorbed oxygen in the oxide insulating barrier. Using bulk niobium single crystals, a knee is observed in the I-V characteristic, although of much smaller size than previously reported. (GRA)

25403 (AD-766482-4) DETERMINING ACCURATE SUPERCONDUCTING TUNNELING ENERGY GAPS: ANISOTROPY IN SINGLE-CRYSTAL Nb. Bostock, J.; Agyeman, K.; Frommer, M. H.; MacVicar, M. L. A. (Massachusetts Inst. of Tech., Cambridge (USA)). 11 Sep 1973. Contract N00014-67-A-0204-0041. 14p. NTIS $2.75.

Superconducting tunneling experiments on niobium single crystals with indium and lead-bismuth counter-electrodes show an isotropic energy gap value of 3.12 plus or minus 0.05 MeV, or 3.93 kT (c), for 26 junction orientations. Self-consistent analysis criteria have been developed for the determination of gap values. These criteria are not met in the existing literature on transition metal tunneling. (auth)

25404 (AD-768317-0-GA) ANISOTROPY OF THE PENETRATION DEPTH IN SUPERCONDUCTING TIN. Tai, P. C. L. (Harvard Univ., Cambridge, Mass. (USA). Div. of Engineering and Applied Physics). Sep 1973. 171p. NTIS $4.75.

The temperature dependence of the penetration depth in superconducting tin was measured using a dc magnetometer. The high sensitivity of the SQUID magnetometer used allowed this to be done on bulk samples to an accuracy of 1A. Single crystals of tin were used as samples in order to measure the anisotropy with respect to crystallographic orientations. Some theories on the penetration depth are presented. They are found to be inadequate for accurate comparison with the present data, because they are either based on the isotropic model or are not easily applicable to tin. To serve as a guide and hopefully to stimulate interest, the present data is fitted to the BCS theory by varying some parameters. The fit is reasonable but some deviations still remain. (GRA)

25405 (ANL-8054) PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON MAGNETIC STRUCTURES IN SUPERCONDUCTORS, ARGONNE NATIONAL LABORATORY, SEPTEMBER 5–8, 1973. (Argonne National Lab., Ill. (USA)). [nd]. Contract W-31-109-eng-38. 105p. (CONF-730978-(Absts.)). Dep. NTIS $5.45.

Fifty-two abstracts of the papers presented at the conference are included, arranged by sessions dealing with intermediate state, mixed state in type-I superconductors, vortex structure, NMR, neutron diffraction, surface impedance, current-induced effects, flux jumps, vortex coupling, tunneling in thin films, etc. A 22-page summary of the conference is also included. (DLC)

25406 (CEA-CONF-2522) PROGRAMME ON APPLICATION OF SUPERCONDUCTIVITY IN FRANCE. Bronca, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 3 Sep 1973. 11p. (CONF-730970-1). Dep. NTIS (U. S. Sales Only) $3.00.

From Advanced Study Institute on large scale, applications of superconductivity and magnetism; Entreves, Italy (5 Sep 1973).

A program on large scale applications of superconductivity to be funded by the government has been established in France by the Delegation Generale à la Recherche Scientifique et Technique. It is oriented towards two main applications. For the near future: support of nuclear physics magnets research which will be applied in the coming years, it will be a good preparation for future other applications. For far future: support of research for turbogenerators, the use of which is forecast about 1985. The other applications do not appear now very promising in our country but work will be done in two fields which will be useful for any applications namely the conductor and the cryogenic supply. (auth)

25407 SUPERCONDUCTIVITY OF THIN Nb_3Sn FILMS UNDER TENSILE STRESS. Pupp, W. A.; Sattler, W. W.; Saur, E. J. (Univ., Giessen, Ger.). J. Low Temp. Phys.; 14: No. 1-2, 1-13 (Jan 1974).

Thin Nb_3Sn films on bendable quartz substrates have been prepared by different methods. These films exhibit an initial tensile stress. Bending the samples by two methods under known conditions results in quantitative changes of tensile stress and in relative changes of the superconducting transition temperature. On the average a "tension coefficient" of about $\Delta T_c/\Delta\sigma \approx -5 \times 10^{-3}$ K/kp mm^{-2} has been found for all samples. A certain influence of the preparation conditions has been observed. The results are in fairly good agreement with similar types of earlier measurements. (auth)

25408 LOCAL STRUCTURE AND THERMODYNAMIC BEHAVIOR OF DIRTY SUPERCONDUCTORS IN THE MIXED STATE AT ARBITRARY TEMPERATURE. Kramer, L. (Kernforschungsanlage, Juelich, Ger.); Pesch. W.; Watts–Tobin, R. J. J. Low Temp. Phys., 14: No. 1-2, 29-51(Jan 1974).

A recent dirty-limit version of the Gor'kov theory is used to calculate numerically the self-consistent structure and free energy of isolated vortices and of the vortex lattice in the circular cell approximation at arbitrary temperature and Ginzburg–Landau parameter k. This yields the lower critical field H_{c1}, the magnetization curve, the electronic specific heat, and the density of states at the Fermi surface. The results are discussed and compared with experiments. (auth)

25409 CALCULATION OF THE STRESS DEPENDENCE OF THE SUPERCONDUCTING TRANSITION TEMPERATURE. Ott, H. R.; Sorbello, R. S. (Eidgenoessische Technische Hochschule, Zurich). J. Low Temp. Phys.; 14: No. 1-2, 73-85 (Jan 1974).

A calculation of the stress dependence of the superconducting transition temperature of non-transition metals using the McMillan equation is described. Effects due to the stress dependence of the pseudopotential and the electronic band structure density of states are included and it is shown that the effective Grueneisen parameter entering the calculation can be approximated by the high-temperature value of the lattice Grueneisen parameter. The numerical results are in reasonable agreement with recent measurements on the influence of hydrostatic pressure and uniaxial stress on the transition temperatures of simple metals. (auth)

25410 IMPORTANT PARAMETER IN HIGH-TEMPERATURE SUPERCONDUCTIVITY. Leavens, C. R.; Carbotte, J. P. (McMaster Univ., Hamilton, Ont.). J. Low Temp. Phys.; 14: No. 1-2, 195-211(Jan 1974).

It is widely held that the single most important parameter describing the strength of the electron–phonon interaction in superconductivity is the mass enhancement factor λ, and that the maximum possible transition temperature for a given class of materials (e.g., the polyvalent metals) is attained for a very large value, $\lambda \approx 3$, of the parameter. It is shown that it is not likely that the highest attainable values of T_c will reflect such large values of λ. Instead, it is expected that they will be associated with values of λ that do not differ greatly from a value of about 1.5, and with very large values of the parameter A, where A is the area under the electron–phonon interaction spectrum $\alpha^2F(\nu)$. This is certainly the case for Nb_3Sn, which has a T_c of 18 K. (auth)

25411 NEUTRON DIFFRACTION STUDIES OF THE MORPHOLOGY OF FLUX LINE CRYSTALS IN TYPE II SUPERCONDUCTORS. Schelten, J.; Lippmann, G.; Ullmaier, H. (Kernforschungsanlage, Juelich, Ger.). J. Low Temp. Phys.; 14: No. 1-2, 213-226(Jan 1974).

Neutron diffraction measurements on flux line single crystals in different type-II materials are reported. It is shown that the type, the perfection, and the orientation of the vortex lattice with respect to the metal crystal mainly depend on the symmetry of the crystal axis which is parallel to the magnetic field. Results on samples with twofold, fourfold, and sixfold symmetry axes are represented and compared with theoretical predictions. The dependence of the widths of rocking curves on temperature and flux density was studied and it is shown that there is a close connection between the mosaic spread of the vortex lattice and its elastic properties. (auth)

25412 LOW-LOSS NIOBIUM–TIN COMPOUND FOR SUPERCONDUCTING ALTERNATING-CURRENT POWER TRANSMISSION APPLICATIONS. Suenaga, M.; Garber, M. (Brookhaven National Lab., Upton, NY). Science; 183: No. 4128, 952-954(8 Mar 1974).

A Nb Sn superconductor has been fabricated in rods and tapes by the interaction of the tin contained in a copper–tin alloy with niobium which had been in contact with the alloy material. This conductor has lower alternating-current (60 hertz) losses than any presently available commercial products. (auth)

25413 SUPERCONDUCTIVITY TRANSITION TEMPERATURES OF RF REACTIVELY SPUTTERED NbN FILMS. Buttig, K.; Liemersdorf, H.; Kinder, H.; Reichelt, K. (Institut für Festkörperforschung, Kernforschungsanlage Jülich, 517 Jülich, Germany). J. Appl. Phys. 44: No. 11, 5069-5071 (Nov 1973).

Niobium nitride films of a thickness ranging from 500 to 3000 Å have been deposited by reactive rf sputtering of niobium in a nitrogen/argon atmosphere. A water-cooled substrate holder was used. The partial pressure of nitrogen was varied systematically between 0 and 10^{-3} Torr at two different argon pressures. Generally, the substrate was set on anode potential but in some cases a bias voltage was applied. The experiments showed that the transition temperature was strongly dependent upon the partial pressures of nitrogen and argon. In the sputtering experiments without bias very steep transition curves were obtained. The highest transition temperature was $T_c = 14.5$ K. The structures of films were examined by x-ray and TEM transmission methods. The investigations made evident that rf sputtering is a method by which high transition temperatures can be obtained, even at high residual gas pressures and unheated substrates. (auth)

25414 ANGULAR DEPENDENCE OF CRITICAL CURRENTS AND TRANSITION FIELDS OF SPUTTER-DEPOSITED SUPERCONDUCTING FILMS. Saito, Y.; Anayama, T. (Department of Electrical Engineering, Tohoku University, Sendai, Japan). J. Appl. Phys. 44: No. 11, 5111-5115 (Nov 1973).

Anisotropies in critical currents and transition fields have been measured for sputter-deposited superconducting films. For thicker films, the peak at $\theta = 90°$ in the I_c–θ characteristics is strongly marked. As the film thickness decreases, the peak at $\theta = 90°$ tends to reduce, and finally disappears in the film thinner than the critical thickness. Furthermore, the transition fields H_t have been found to be anisotropic with respect to the applied field direction θ. The marked peak at $\theta = 90°$ in the H_t–θ characteristics is found for films thicker than the critical thickness. (auth)

25415 CRITICAL CURRENTS OF SUPERCONDUCTING CONDUCTORS MEASURED BY NEW TECHNIQUE. Mathur, M.P.; Deis, D.W.; Ashkin, M. (Westinghouse Research Laboratories, Pittsburgh, Pennsylvania 15235). J. Appl. Phys. 44: No. 11, 5116-5119 (Nov 1973).

A magnetic torque technique for measuring critical current densities is described. Results obtained on Nb–Cu and (Nb–Ti) –Cu composite conductors by this technique are presented and compared with direct transport current measurements. (auth)

25416 SELF COUPLED TRAVELLING WAVE MODEL FOR SUPERCONDUCTING TUNNEL JUNCTIONS. Hasselberg, L. E. (Kungliga Tekniska Hoegskolan, Stockholm). J. Phys., F (London); 4: No. 1, 154-166(Jan 1974).

The Tien–Gordon expression (Phys. Rev.; 129: 647-51 (1963)) for the quasi-particle current against an exterior rf voltage is in conflict with Maxwell's equations, if the rf voltage is space independent. With the help of a travelling wave model for the microwaves in the oxide barrier and self coupling of the current via the wave number of the travelling waves, the problem has been solved for small rf amplitudes. The self coupling results in a nonlinear dispersion relation for the travelling waves. (auth)

25417 ACHIEVEMENT OF VERY HIGH CRITICAL CURRENTS IN TYPE II SUPERCONDUCTORS. Timms, W. E.; LeBlanc, M. A. R. (Univ. of Ottawa). J. Phys., F (London); 4: No. 1, 136-153(Jan 1974).

Persistent currents are induced to flow along a ribbon of a type-II superconductor placed in a static longitudinal field $H_{||}$ by the sweep of a transverse field component directed along the flat faces. The induced magnetic moments, hence the induced critical current densities, are considerably enhanced when a longitudinal field is present and maximum magnitudes are encountered when $H_{||} \simeq 0.6\ H_{c2}$. Exploiting the critical state concept together with the idea that pinning force densities depend on the magnetic induction B and display a broad peak when B is a significant fraction of H_{c2}, families of magnetization curves are calculated which reproduce the general behavior of the observations. Further, when a static longitudinal field permeates the ribbon, a magnetic moment appears along the length of the sample as the transverse field is varied. This phenomenon is studied and attributed to the adoption by the induced currents of patterns of circulation which tend to be force free. Introducing this feature in the calculations of the transverse moments leads to a better fit with the observations. (auth)

25418 MICROWAVE ABSORPTION IN 2H$-$NbSe$_2$ AND CRITICAL FLUCTUATIONS ABOVE T_c. Monceau, P.; Waysand, G. (CNRS, Grenoble, France). Solid State Commun.; 14: No. 3, 221-224(1 Feb 1974).

Large three-dimensional critical fluctuations above T_c have been observed in 2H-NbSe$_2$ (double-hexagonal) compounds by microwave absorption. (auth)

25419 IMPROVED CRITICAL CURRENT CAPABILITY OF V_3Ga FORMED IN A V$-$6Ga/Cu$-$15Ga COMPOSITE. Weinman, L. S.; Meussner, R. A.; Howe, D. G. (Naval Research Lab., Washington, DC). Solid State Commun.; 14: No. 3, 275-277(1 Feb 1974).

Single filament V_3Ga composite wires were prepared by imbedding cores of pure V and V$-$6.1 at.% Ga in a Cu$-$15.4 at.% Ga matrix. The parabolic growth rate of V_3Ga was enhanced by alloying the core, and the superconducting critical current density was nearly doubled. At 4.2 K J_c exceeded 10^5 A/cm^2 in transverse magnetic fields up to 140 kG. (auth)

25420 SIMPLE PHENOMENOLOGICAL APPROACH TO THE PHASE-DEPENDENT CONDUCTIVITY OF A SUPERCONDUCTING WEAK LINK. Deaver, B. S. Jr.; Sandell, R. D.; Vincent, D. A. (Univ. of Virginia, Charlottesville). Phys. Lett.; 46A: No. 6, 411-412(28 Jan 1974).

Dependence of the pair density on pair velocity and consequently on the phase difference for a metallic weak link implies a phase-dependent conductivity which is calculated using a simple phenomenological approach. (auth)

25421 TEMPERATURE DEPENDENCE OF THE RESISTANCE OF A SURFACE LAYER IN INDIUM ANTIMONIDE IN THE SUPERCONDUCTIVITY TRANSITION REGION. Abdullaev, A.; Vitovskii, N.A.; Krymova, E.D.; Mashovets, T.V.; Ryvkin, S.M.; Shik, A.Y. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Semicond. 7: No. 5, 628-629 (Nov 1973).

An investigation was made of the temperature and current dependences of the resistance of a surface layer in indium antimonide in the superconducting transition region. For sufficiently low currents these dependences are of a power nature with an exponent close to 3/2. It is suggested that superconducting regions are in the form of thin (almost one-dimensional) filaments on the surface of a sample. (auth)

25422 INFLUENCE OF THE TRANSITION-METAL IMPURITIES ON THE CRITICAL TEMPERATURE OF SUPERCONDUCTING ALLOYS. Kon, L. Z. (Inst. of Applied Physics, Kishinev). Phys. Lett., 46A: No. 5, 327-328(14 Jan 1974).

A new approximation for the Coulomb term of Anderson's model is used to obtain an equation for the critical temperature of dilute superconducting alloys. This equation can be used to describe the magnetic$-$nonmagnetic transition. (auth)

25423 SUPERCONDUCTIVITY IN Nb$-$Mo ALLOYS: POSSIBLE INFLUENCE OF A DIP IN THE LONGITUDINAL ACOUSTIC PHONON MODE. Cappelletti, R. L. (Univ. of Ohio, Athens). Phys. Lett., 46A: No. 5, 315-316(14 Jan 1974).

Empirically determined $\langle\omega^2\rangle^{1/2}$ correlates well with the frequency of a dip in the [00ζ] LA phonon branch in Nb$-$Mo alloys. This possibly indicates the importance of this dip to their superconductivity. (auth)

25424 MAGNETIZATION OF TYPE-II SUPERCONDUCTORS IN THE MIXED STATE. Khanra, B. C.; Raychaudhuri, A. K. (Saha Inst. of Nuclear Physics, Calcutta). Phys. Lett., 46A: No. 5, 311-312(14 Jan 1974).

The variational method, used in a previous work to study an isolated vortex tube, has been extended to calculate the magnetization of type-II superconductors for arbitrary values of Ginzburg$-$Landau parameter κ and over the whole range of the magnetic field from hc_1 to hc_2. The results are discussed. (auth)

25425 ELECTRON-PHONON INTERACTION IN A STRONGLY COUPLED SUPERCONDUCTOR, MERCURY: TEMPERATURE DEPENDENCE OF THE EFFECTIVE MASS. van Dorpe, C. Brussels; Univ. Brussels (1973). 56p. (In French). Thesis.

The effect of the electron$-$phonon interaction on the properties of the conduction electrons of a normal metal involves a modification of the energy associated with them. At low temperature modifications of the self-energy with respect to processes at zero temperature are observed. Among the different metals for which the temperature dependence of the effective mass has been calculated or observed by cyclotron resonance measurements Hg is the only element on which it is possible to observe it by measurements of magnetization heat. The temperature dependence of the renormalization of the electron entropy due to the electron$-$phonon interaction was shown. Although this effect has been predicted for a long time, it has never been confirmed directly by experiment because of the difficulties associated with the contribution of the lattice. The experimental technique developed gives the superconductor electron entropy with great precision and permits the precise determination of the electron specific heat. (tr-auth)

25426 PRESSURE DEPENDENCE OF THE SUPERCONDUCTING TRANSITION TEMPERATURES OF PdH AND PdD. Schirber, J. E. (Sandia Labs., Albuquerque, NM). Phys. Lett., 46A: No. 4, 285-286(31 Dec 1973).

The pressure dependence of the superconducting transition temperatures of PdH and PdD with transition temperatures in the range 2 to 7 K has been measured. $d \ln T_c/dP$ ranges from -0.013 kbar^{-1} near 2 K to -0.008 kbar^{-1} near 7 K. (auth)

25427 CRITICAL CURRENT IN NARROW SUPERCONDUCTING LINKS. Volkov, A.F. (Institute of Radio Engineering and Electronics, Academy of Sciences of the USSR, Moscow). Sov. Phys.–Solid State 15: No. 5, 925-927 (Nov 1973).

The spatial dependences of the order parameter and of the critical current in a thin-film link are calculated. The calculation is based on the Ginzburg–Landau equation including the nonlinear terms. The expression for the critical current is identical with the corresponding expression obtained by Aslamazov and Larkin if the quantity R in their formula is regarded as the resistance of the link measured at a distance ξ from the center of the link (ξ is the coherence length). (auth)

25428 EXCITATION OF ACOUSTIC OSCILLATIONS IN SUPERCONDUCTING FILMS. Golub, A.A. (Institute of Applied Physics, Academy of Sciences of the Moldavian SSR, Kishinev). Sov. Phys.–Solid State 15: No. 5, 988-990 (Nov 1973).

A study is made of the excitation of sound in a superconducting film by electromagnetic waves incident on the surface of the film. It is assumed that the thickness of the film d is much greater than the penetration depth of the field. If the acoustic wave is damped over a distance of the order of d, traveling acoustic waves can be excited in the superconductor; otherwise, standing waves are excited. The low–temperature contribution of acoustic oscillations to the surface resistance of pure superconductors is calculated. At very low temperatures, the absorption of electromagnetic waves is mainly governed by the losses due to acoustic oscillations. (auth)

25429 NONTHERMAL DISCONTINUITY IN THE CURRENT–VOLTAGE CHARACTERISTIC OF A THIN SUPERCONDUCTING FILM. Eru, I.I.; Peskovatskii, S.A.; Poladich, A.V. (Institute of Radiophysics and Electronics, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Solid State 15: No. 5, 1069-1070 (Nov 1973).

Current–voltage characteristics of tin and lead thin films on optically polished sapphire substrates were studied in the temperature range from 1.9°K to the critical value. All of the I–V curves obtained show a discontinuity for $V < V_{min}$ (V_{min} is material and temperature dependent) and it is postulated that this discontinuity is a characteristic common to all superconducting thin films. (AIP)

25430 SUPERCONDUCTIVITY OF MERCURY IN ZEOLITES HAVING A THREE–DIMENSIONAL CHANNEL NETWORK. Bogomolov, V.N. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Solid State 15: No. 4, 893-893 (Oct 1973).

Observed changes in superconducting transition temperature at 600 Hz of NaX:Hg at 18 kbars and NaA:Hg at 20 kbars is mainly attributed to the metal–dielectric interaction. (AIP)

25431 MAGNETIC SUSCEPTIBILITY AND SUPERCONDUCTIVITY OF SOLID SOLUTIONS OF NIOBIUM AND TUNGSTEN MONOÇARBIDES. Dubrovskaya, L.B.; Rabin'kin, A.G. (Institute of Chemistry, Ural Scientific Center, Academy of Sciences of the USSR, Sverdlovsk). Sov. Phys.–Solid State 15: No. 4, 875-876 (Oct 1973).

Superconducting transition temperature and magnetic susceptibility in the temperature range 300–1300°K are measured for $Nb_{1-x}W_xC_y$ solid solutions with $0 \leq x < 0.10$ and $0.93 \leq y \leq 1.05$. (AIP)

25432 SUPERCONDUCTIVITY OF Nb AND Ta AT PRESSURES UP TO 250 kbar. Berman, I.V.; Brandt, N.B.; Zarubina, O.A.; Karuzskii, A.L. (M. V. Lomonosov Moscow State University). Sov. Phys.–Solid State 15: No. 4, 732-734 (Oct 1973).

The critical temperature T_k of Nb and Ta was studied as a function of the pressures between 0 and 250 kbar. For Nb the T_k value passes through a minimum at $P \simeq 40$ kbar, and then increases $[dT_k/dp = (2.6 \pm 0.2)\cdot 10^{-6}$ deg/bar$]$; for Ta the T_k value decreases in the range $P \simeq 01-100$ kbar, remaining essentially constant thereafter. The results are discussed in connection with existing theories. (auth)

25433 SUPERCONDUCTIVITY AND STRUCTURE OF Ti–Nb ALLOYS SUBJECTED TO HYDROSTATIC PRESSURES UP TO 120 kbar. Afonikova, N.S.; Degtyareva, V.F.; Litvin, Y.A.; Rabin'kin, A.G.; Skakov, Y.A. (Institute of Chemical Physics, Academy of Sciences of the USSR). Sov. Phys.–Solid State 15: No. 4, 746-749 (Oct 1973).

A study is made of the structure and the superconducting properties of alloys of Ti with 10–90 at.% Nb subjected to pressures up to 120 kbar. An x–ray structural analysis shows that the ω phase is formed in alloys with 10 and 20 at.% Nb at pressures of 30 and 50 kbar, respectively, and that it is retained upon pressure release in a metastable state at $P=1$ atm, there being an accompanying and significant depression of the T_C of the alloys. Pressure treatment at 120 kbar of the alloy with 10 at.% Nb results in the appearance in a metastable state of the ω phase along. It is shown that, irrespective of whether the ω phase is produced by the action of pressure or by ordinary heat treatment, its structure and lattice parameters are much the same, although formation of the ω phase by heat treatment is accompanied by an increase of T_C. Some possible reasons for the dependence of T_C on the process of formation of ω phase (by heat treatment or by pressure) are considered. Alloys with 30 and 40 at.% Nb subjected to 120 kbar also exhibit a significant reduction of T_C, indicating that the ω phase has been formed in them. As is well known the ω phase cannot be produced in such alloys by heat treatment. (auth)

25434 THEORY OF RELAXATION PROCESSES IN SUPERCONDUCTORS. Bar'yakhtar, V.G.; Klepikov, V.F.; Seminozhenko, V.P. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Solid State 15: No. 4, 817-822 (Oct 1973).

The relaxation time has been calculated in a system of electronic excitations and phonons for $T<T_c$ and $T\sim T_c$. For $T \ll T_c$ an equilibrium temperature distribution is initially established in the system of electronic excitations due to scattering processes with emission or absorption of a phonon and then there is relaxation to the equilibrium value of the quasiparticle number due to decay and recombination processes. Phonon relaxation for $T<T_c$ arises from collisions of phonons with each other after which the equilibrium between phonons and electrons is gradually established due to the electron–phonon interaction. In the region where $T\sim T_c$, the two–step nature of the relaxation of both phonons and electrons vanishes and the relaxation in the superconductor resembles relaxation in a normal metal. (auth)

25435 ANOMALOUS TEMPERATURE DEPENDENCE OF THE SUSCEPTIBILITY AND STRUCTURAL TRANSITIONS IN COMPOUNDS WITH HIGH SUPERCONDUCTING TRANSITION TEMPERATURES T_c. Kodess, B.N. (S. M. Kirov Ural Polytechnic Institute, Sverdlovsk). Sov. Phys.–Solid State 15: No. 4, 844-845 (Oct 1973).

Correlations between the temperature dependence of paramagnetic susceptibility between 20 and 300°K and T_c for compounds in the system $Nb_3(Al,Ge)$ are interpreted in terms of changes in the density of electronic states. (AIP)

25436 MEASUREMENT OF THE PROBABILITY DISTRIBUTION OF THERMALLY EXCITED FLUXOID QUANTUM TRANSITIONS IN A SUPERCONDUCTING RING CLOSED BY A JOSEPHSON JUNCTION. Jackel, L.D.; Webb, W.W. (School of Applied and Engineering Physics, and Laboratory for Atomic and Solid State Physics, Cornell University, Ithaca, New York 14850); Lukens, J.E.; Pei, S.S. Phys. Rev. B 9: No. 1, 115-118 (1 Jan 1974).

The thermally induced distribution of transitions between fluxoid quantum states of a superconducting ring closed by a Josephson junction has been measured. The observed dependence of its width σ on temperature, ring inductance, and weak–link critical current, as well as its shape, confirms the recent theoretical results of Kurkijarvi, $\sigma \propto L(i_c)^{1/3}T^{2/3}$. (auth)

25437 APPLICATIONS OF THE BOSON FORMALISM TO MAGNETIC PROPERTIES OF SUPERCONDUCTORS. Mancini, F.; Scarpetta, G. (Istituto Di Fisica, Universita Di Salerno, Via Vernieri 42, 84100 Salerno, Italy); Srinivasan, V.; Umezawa, H. Phys. Rev. B 9: No. 1, 130-134 (1 Jan 1974).

The single–vortex neutron scattering form factor of $Nb_{0.27}Ta_{0.73}$, the magnetization curves of vanadium ($\kappa = 0.85$), niobium ($\kappa = 0.81$), and a case of $\kappa = 0.67$ are calculated by means of the boson formalism. The results agree with experiments very well. The order of the phase transition around H_{c1} is discussed. (auth)

25438 SUPERCONDUCTING CRITICAL FIELDS OF THIN FILMS OF Sn, Ga, AND Al: EFFECTS OF ELECTRON PARAMAGNETISM. Crow, J.E.; Strongin, M. (Brookhaven National Laboratory, Upton, New York 11973); Bhatnagar, A.K. Phys. Rev. B 9: No. 1, 135-138 (1 Jan 1974).

The effect of paramagnetism on the critical field of very thin films of aluminum and disordered tin and gallium has been experimentally investigated to determine the spin–orbit scattering time τ_{so}. Values of τ_{so}, so determined, are found to be in reasonable agreement with the scaling of the impurity scattering time τ_{tr} by a term proportional to fourth power of atomic number of the metal as predicted by Abrikosov and Gorkov. (auth)

25439 LOCALIZED DESCRIPTION OF SUPERCONDUCTIVITY IN NARROW–BAND METALS. Birnboim, A.; Gutfreund, H. (The Racah Institute of Physics, The Hebrew University of Jerusalem, Jerusalem, Israel). Phys. Rev. B 9: No. 1, 139-146 (1 Jan 1974).

A localized description of superconductivity in narrow–band metals, proposed by Appel and Kohn, is applied to the calculation of the phonon–exchange vertex in three transition metals. The essence of this description is the formulation of the equation for the vertex function in the Wannier representation and the assumption of a contact interaction, in which the two electrons in a Cooper pair scatter together from site to site. The value of the vertex function at $\omega = 0$ plays the same role in determining T_c as the coupling parameter λ in the BCS— or McMillan—theory. The phonon–exchange vertex is calculated for V, Nb, and Ta, assuming that the d electrons occupy the threefold degenerate Γ'_{25} band. The calculation makes use of tabulated atomic wave functions and potentials, and of measured phonon frequency distributions. The electron–phonon interaction is described within the so called modified tight–binding approximation, in which the zeroth–order electron wave functions follow adiabatically the vibrating ions. The values of the phonon–exchange vertex at $\omega = 0$ are compared with λ given by McMillan and correct orders of magnitude are obtained with reasonable screening of the atomic potentials. The validity of the contact approximation is checked numerically. (auth)

25440 ELECTRON–SPIN RESONANCE OF A LOCALIZED MOMENT IN THE SUPERCONDUCTING STATE: BRu_2:Gd (B = La, Ce, Th). Davidov, D.; Rettori, C.; Kim, H.M. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. B 9: No. 1, 147-153 (1 Jan 1974).

The electron–spin–resonance spectrum of Gd in the type–II cubic superconductors $LaRu_2$, $CeRu_2$, and $ThRu_2$ has been observed in both the normal and superconducting regimes. Upon transition from the normal to the superconducting state, the spectra exhibit (a) a change in line shape (A/B ratio), (b) an increase in thermal broadening immediately below $T_c(H)$, and (c) a change in g value. Comparison with experiments performed by others, as well as a preliminary interpretation of the data, is presented. (auth)

25441 THEORY OF FLUCTUATION SUPERCONDUCTIVITY FROM ELECTRON–PHONON INTERACTIONS IN PSEUDO–ONE–DIMENSIONAL SYSTEMS. Allender, D.; Bray, J.W.; Bardeen, J. (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). Phys. Rev. B 9: No. 1, 119-129 (1 Jan 1974).

The physics of quasi–one–dimensional solids which undergo a Peierls distortion, such as the organic material TTF–TCNQ (tetrathiofulvalinium–tetracyanoquinodimethane) is discussed. In particular, the effect of fluctuations into the Fröhlich superconducting state on the free energy and the electrical conductivity is examined theoretically at temperatures above that of the Peierls distortion. A phenomerological approach is used, but the physical basis for a microscopic treatment is given and the results are compared with the effect of fluctuations into a BCS superconducting state. It is found that such fluctuations give a paraconductivity which is too small to account for the extraordinary conductivity peaks reported for TTF–TCNQ. (auth)

25442 SURFACE SUPERCONDUCTIVITY IN NIOBIUM AND NIOBIUM–TANTALUM ALLOYS. Hopkins, J.R.; Finnemore, D.K. (Ames Laboratory–USAEC and Department of Physics, Iowa State University of Science and Technology, Ames, Iowa 50010). Phys. Rev. B 9: No. 1, 108-114 (1 Jan 1974).

The critical field for surface superconductivity, H_{c3}, and the upper bulk critical field, H_{c2}, have been measured as a function of temperature and mean free path for Nb and Nb(Ta) alloys in an attempt to study the spatial variations of the superconducting interaction constant $N(0)V$ near a vacuum–metal interface. At temperatures below $T/T_c = 0.85$, the pure–Nb sample shows H_{c3}/H_{c2} values well above 1.695, as predicted by Hu and Korenman for the limit of long electronic mean free path. As the mean free path decreases, there is a regular depression of H_{c3}/H_{c2} toward 1.695. At temperatures above $T/T_c = 0.85$, however, there are striking deviations from the theory which may arise because the interaction constant is slightly depressed at the surface. A model calculation by Hu shows that changes in $N(0)V$ at the surface of 0.7% for pure Nb and 1.6% for Nb–1.0–at.% Ta can account for the experimental results. (auth)

25443 PEIERLS–FROEHLICH INSTABILITY AND SUPERCONDUCTIVITY IN LINEAR CHAIN CRYSTALS. Gutfreund, H. (Hebrew Univ., Jerusalem); Horovitz, B.; Weger, M. J. Phys., C (London); 7: No. 2, 383–388(21 Jan 1974).

The transition to insulating or superconducting states in linear chain systems is discussed in relation to the recently observed paraconductivity in TTF-TCNQ crystals. A relation between T_C, the Peierls transition temperature T_p, and the electron–phonon coupling strength is derived using the random phase approximation and a simplified form of the strong coupling equation for T_c. It is argued that in principle one can have either $T_p > T_c$ or $T_c > T_p$. (auth)

25444 STABILITY OF THE MOVEMENT OF A PLANAR INTERPHASE BOUNDARY BETWEEN NORMAL AND SUPERCONDUCTING DOMAINS. Lievre, C.; Rothen, F. (Univ., Lausanne, Switzerland). Helv. Phys. Acta; 46: No. 2, 213-229(15 Aug 1973).

A study was made of the stability and motion of an interphase boundary between normal and superconducting domains during the destruction of superconductivity by a greater than critical magnetic field, uniform, constant, and parallel to the surface of a half-space. When the boundary shape or position is perturbed, it is stable, and in these two cases the motion is asymptotically given by the solution of Pippard and Lifshitz. A more general description of the boundary motion is also derived. (auth)

25445 PROSPECTS FOR SUPERCONDUCTIVE GENERATORS IN THE ELECTRIC UTILITY INDUSTRY. Jefferies, M. J.; Gibbs, E. E.; Fox, G. R.; Holley, C. H.; Willyoung, D. M. (General Electric Co., Schenectady, NY). IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst.; PAS-92: No. 5, 1659-1669(1973).

The possibility of employing superconductors for the field windings of large AC generators, providing essentially unlimited field capability and eliminating field ohmic losses is discussed. Some of the benefits and challenges in reducing this exciting new technology to practice in large AC generators are outlined. The discussion was directed toward the performance characteristics and technical considerations of 2000 MVA, two-pole and four-pole superconductive generators, and their relationship to the application and performance of the total power system. Economics associated with the reliability and availability of the power generation equipment are considered. A comparison was made of conventional and superconducting generator sizes. (MCW)

25446 SUPERCONDUCTIVITY IN TRANSITION METAL ALLOYS: AN ALTERNATIVE TO THE RIGID BAND MODEL. II. Miedema, A. R. (Philips Gloeilampen-Fabrieken NV, Eindhoven, Netherlands). J. Phys., F (London); 4: No. 1, 120-135(Jan 1974).

In a recent paper (Miedema, J. Phys. F: Metal Phys.; 3(1973)) an account has been given of the electronic heat capacities γ, of transition metal solid solutions in terms of an empirical model in which the different metals in the alloy are assumed to contribute individually to γ. In the present paper the model is applied to the superconductive transition temperature. It is demonstrated that a fair description of the experimental data available on superconductive transition metal solid solutions is obtained if in the alloy the metals are supposed to contribute individually to $-(\ln (T_c/\theta_D)^{-1})$. Within a simple BCS formalism the additivity assumed for this quantity is equivalent to the additivity of densities of states and that of electronic heat capacities. In addition, both heat capacity and superconductivity of transition metal random alloys are reconsidered, taking into account phonon enhancement and separate attractive and repulsive electron-electron interactions. It is concluded that the density of states at the Fermi level, N(0), shows maxima at $Z \simeq 3.3, 5.3, 7.3, 8.8$ and 10. This result partly contradicts rigid band type conclusions. (auth)

25447 VALIDITY OF BRAGG'S RULE IN SPUTTERED SUPERCONDUCTING NbN AND NbC FILMS OF VARIOUS COMPOSITIONS. Meyer, O.; Linker, G.; Kraeft, B. (Kernforschungszentrum, Karlsruhe, Ger.). Thin Solid Films; 19: No. 2, 217-226(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

Niobium nitride layers were produced by reactive sputtering in an argon-nitrogen plasma. Compositions were varied by altering the nitrogen partial pressure during the sputtering process. Changes in composition were determined by measuring the niobium peak height at the layer surface in back-scattered spectra, as well as by measuring the superconducting transition temperature T_c in homogeneous layers. These results are compared with niobium peak heights calculated as a function of the ratio of the number of nitrogen atoms to niobium atoms, using experimental and theoretical stopping cross sections for $^4He^+$ ions in niobium and nitrogen. Assuming the validity of Bragg's rule in this calculation the measured values are found to be 7 to 8% smaller than those calculated. As uncertainties exist in present values of the stopping cross sections of Nb and N it is concluded that the observed deviation is too small to indicate whether or not Bragg's rule is applicable. During the production of NbC layers in an Ar plasma the Nb target was covered by a perforated carbon plate. Stoichiometric layers have been produced with T_c values similar to that for bulk samples. The deviation between calculated and measured Nb peak heights is of the same order of magnitude as that found for NbN. (auth)

25448 HIGH FIELD SUPERCONDUCTIVITY IN THIN FILMS. Fulde, P. (Institut Max von Laue-Paul Langevin, Garching, Ger.). Advan. Phys.; 22: No. 6, 667-719(Nov 1973).

Thin films provide an ideal means for studying the role of spin paramagnetism in the theory of superconductivity. A review is given of the present state of theoretical and experimental work. It includes a study of the excitation spectrum of thin films in a parallel magnetic field and the experimental evidence of Zeeman splitting of superconducting quasiparticles. The role of spin-orbit interaction is discussed in detail. The application of spin selective tunnelling is shown. Furthermore, a study is included of the order of phase transition between the normal state and the paramagnetically limited superconducting state. A detailed discussion is given of the generalized Ginzburg-Landau equation including numerical evaluations. The applicability of Tinkham's formula [Phys. Rev.; 129: 2417 (1963)] is discussed, which is relevant for the determination of critical fields of arbitrary orientations to the film. Finally, an account is given of the work which deals with the influence of spin paramagnetism on superconducting fluctuations. Recent experimental and theoretical work is described and discussed. (auth)

25449 TUNNELING ANOMALY IN JUNCTIONS OF EXTREMELY THIN SUPERCONDUCTING METAL FILMS. Gromer, J.; Sixl, H. (Univ., Stuttgart). Solid State Commun.; 14: No. 4, 353-355(15 Feb 1974).

The tunneling spectra of extremely thin Al, In and Pb films show an increase of the dynamic resistance in the low bias range. This tunneling anomaly can be explained by size quantization of the electronic states in small particles. (auth)

25450 CPA TREATMENT OF SUPERCONDUCTING ALLOYS. Weinkauf, A.; Zittartz, J. (Univ., Cologne). Solid State Commun.; 14: No. 4, 365-368(15 Feb 1974).

A theory for superconducting alloys is formulated on the basis of the Coherent-Potential-Approximation (CPA) to treat the disorder problem. Using a simple model for the density of states, the transition temperature is calculated as a function of the concentration and compared with experiments. (auth)

Equipment and Devices

25451 (BNL-18346) REVIEW OF BROOKHAVEN NATIONAL LABORATORY SUPERCONDUCTING POWER TRANSMISSION PROGRAM. Jensen, J. E. (Brookhaven National Lab., Upton, N.Y. (USA)). 11 Oct 1973. 12p. Dep. NTIS $3.00.

Research is being conducted at Brookhaven National Laboratory to develop a superconducting ac cable system leading to the construction of a ½ mile model cable of 200 MVA capacity at Brookhaven and a cable of larger (>2000 MVA) capacity for test at a utility testing site. It is a coaxial cable of flexible design using Nb_3Sn superconductor, and a tape wound dielectric, helium impregnated, of a material yet to be determined. The research development is reported on the dielectric materials, cryogenic enclosure, refrigeration, and superconducting materials. (MCW)

25452 (LA-5468-PR) USAEC-DAT DC SUPERCONDUCTING POWER TRANSMISSION LINE PROJECT AT LASL. Progress Report, July 1-September 30, 1973. Keller, W. E.; Taylor, R. D. (comps.). (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 28p. Dep. NTIS $4.00.

This third progress report of the Los Alamos Scientific Laboratory DC Superconducting Power Transmission Line (SPTL) Development Project covers the period July 1 to September 30, 1973. The principal findings of two study contracts on feasibility and costs involved in building a commercial SPTL are summarized. Experimental critical current results for Nb_3Sn tapes in several geometries and numerical calculations of the magnetic field profile assuming various models of the current distribution are presented. Continued progress in the areas of fabrication, superconducting materials, and test-bed operation is reported. (auth)

25453 PARAMETRIC EXCITATION OF PLASMA OSCILLATIONS IN JOSEPHSON JUNCTIONS. Pedersen, N.F.; Samuelsen, M.R.; Saermark, K. (Physics Laboratory I, The Technical University of Denmark, DK-2800 Lyngby, Denmark). J. Appl. Phys. 44: No. 11, 5120-5124 (Nov 1973).

A theory is presented for parametric excitation of plasma oscillations in a Josephson junction biased in the zero voltage mode. A threshold curve for the onset of the parametric excitation is deduced via the stability properties of a Mathieu differential equation obtained by a self-consistent linearization procedure. The important parameters turn out to be the plasma frequency and the circuit losses. The results of the calculation are compared with the experiments performed on a Josephson junction analog and good agreement is obtained. It is suggested that the effect should be observable in tunnel junctions, but perhaps less likely in point contacts. (auth)

25454 EFFECT OF TEMPERATURE ON THE ELECTRICAL AND MICROWAVE PROPERTIES OF SUPERCONDUCTING POINT CONTACTS. Gubankov, V.N.; Margolin, N.M.; Filimonov, A.B. (Institute of Radio Engineering and Electronics, Academy of Sciences of the USSR, Moscow). Sov. Phys.–Solid State 15: No. 4, 849-850 (Oct 1973).

Temperature effects on current–voltage characteristics, critical current and 38GHz microwave current oscillations in superconducting Nb–Nb and Sn–Sn point contacts are studied and evaluated. (AIP)

25455 SUPERCONDUCTING PARTIALLY STABILIZED SOLENOID WITH INNER DIAMETER OF 35 CM. Glasov, B.V.; Drui, O.S.; Kurnosov, V.I.; Merzlikin, V.A.; Nikolaev, G.T.; Yuferov, V.B. (Physical Institute, Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.–Tech. Phys. 18: No. 3, 406-408 (Sept 1973).

A solenoid has been built of a partially stabilized wire based on the NT2–50 alloy. The effect of paraffin impregnation on the critical parameters of the solenoid is investigated. The critical current L_{cr} is found to be independent of the rate of rise of the current the range 0–160 A/min. The energy released in the solenoid winding is plotted against the rate of change of the magnetic field for different solenoid currents. (auth)

25456 PAIR–QUASIPARTICLE INTERFERENCE CURRENT IN SUPERCONDUCTING JUNCTIONS. Stephen, M. J. (Rutgers–The State Univ., New Brunswick, NJ). Phys. Lett., 46A: No. 4, 289–290(31 Dec 1973).

The dissipative pair-quasiparticle interference current in a superconducting junction is shown to satisfy a Kramer–Kronig relation. The effects of the noise in this current on the current-voltage characteristics are determined. (auth)

25457 AC LOSSES IN SUPERCONDUCTING MAGNETS AT LOW EXCITATION LEVELS. Hunt, T.K. (Scientific Research Staff, Ford Motor Company, Dearborn, Michigan 48121). J. Appl. Phys. 45: No. 2, 907-913 (Feb 1974).

Levitation of high-speed transportation vehicles carrying superconducting magnets may be achieved by repulsion from the currents induced in a conducting guideway. The vertical accelerations of such vehicles moving over a guideway of finite roughness will lead to alternating currents in the superconducting magnets and thus to power dissipation in the cryogenic system. Previous investigators have concluded that the resulting contribution to the cryogenic heat load may be as great as that from all other sources and thus impose serious weight and space penalties on the over-all system design. These investigators have quite generally assumed that the alternating fields will completely penetrate the superconducting wire at all field levels and that the use of twisted multifilament composite wire is thus essential if ac losses are to be minimized. We show that this assumption is incorrect and that it results in a significant overestimate of the loss in multicore wire at the low alternating field levels appropriate for the full-scale vehicle–guideway system. Our analysis further predicts, and our experiments confirm, that an order-of-magnitude improvement in low-level ac loss performance can be achieved merely by the substitution of single-core superconducting wire for the multicore wire ususally proposed. This should reduce the ac loss to about 1.3 W/vehicle from the 14 W for a typical multicore wire. We find a cubic dependence of the loss rate on the alternating field level, and this implies that an additional loss reduction would accrue if the coil bundle could be expanded to reduce the average current density while preserving the total current and lift force. By these means the ac loss contribution to the cryogenic heat load of a levitated vehicle could be made quite negligible. (auth)

25458 CAVITY SELF-INDUCED STEP FOR A DAYEM BRIDGE. Levinsen, M.T. (Physics Laboratory I, H. C. Ørsted Institute, University of Copenhagen, Copenhagen, Denmark). Appl. Phys. Lett. 24: No. 5, 247-249 (1 Mar 1974).

The existence of radiation from a Dayem bridge is demonstrated by the observation of a self-induced cavity step. The form of the step is explained in terms of a dc-current-biased resistively shunted ideal Josephson device coupled to a resonance circuit. The behavior when a capacitor is included is also discussed. (auth)

25459 EVIDENCE FOR SURFACE-STATE-ENHANCED FIELD EMISSION IN RF SUPERCONDUCTING CAVITIES. Schwettman, H.A.; Turneaure, J.P.; Waites, R.F. (Department of Physics and High Energy Physics Laboratory, Stanford University, Stanford, California 94305). J. Appl. Phys. 45: No. 2, 914-922 (Feb 1974).

Measurements of the x radiation and the electron loading in a niobium cavity resonant in the TM_{010} mode at 1208 MHz have been made in order to study enhanced electron field emission in superconducting cavities. Measurements have also been made of the low-temperature dc electron field emission from bismuth, niobium, copper, and tungsten utilizing a configuration which approximates the point-to-plane geometry. In the rf cavity measurements, it is found that the x-radiation count rate data follow a modified Fowler–Nordheim equation, which takes into account the time-dependent rf fields, the electron dynamics in the rf fields, the emission of secondary electrons, and the production and absorption of x radiation. Further, it is found that the x radiation from the cavity can be reduced by a factor of 10^4–10^6 by helium-ion sputter processing at low temperature. From x-radiation data and electron loading data interpreted with the modified Fowler–Nordheim equation, it has been shown that, after helium-ion sputter processing at low temperature, the electron field emission process can be consistently described by ordinary Fowler–Nordheim electron field emission from geometrical projections at which the electric field is enhanced. Before processing, the electron field emission process cannot be consistently described by ordinary Fowler–Nordheim electron field emission. A point of view which is consistent with the data is that before helium-ion sputter processing the electron field emission is enhanced by resonant tunneling through surface states due to adsorbed atoms, and that as a result of processing, the adsorbed atoms are removed. This point of view is supported by calculated sputtering rates during the processing. In the dc measurements, it is found that the low-temperature electron field emission is consistent with the Fowler–Nordheim theory for an emission tip that has been cleaned by reverse field desorption. However, it is found that the dc electron field emission increases slowly with time, presumably as a result of adsorption of material ejected by electron bombardment of the anode. The resulting changes in the dc electron field emission characteristics are of just the type expected for resonant tunneling through adsorbate surface states, and are remarkably similar to the differences in x-radiation count rate data observed for a superconducting cavity before and after helium-ion sputter processing. (auth)

25460 ac LOSS IN A TWISTED FILAMENTARY SUPERCONDUCTING WIRE. Carr, W.J. Jr. (Westinghouse Research Laboratories, Pittsburgh, Pennsylvania 15235). J. Appl. Phys. 45: No. 2, 929-934 (Feb 1974).

Calculations are made for the ac losses in a twisted filamentary superconductor by assuming a continuum model with anisotropic conductivity. The Maxwell equations are solved for a long wire of radius R_0 and twist length L. In terms of the classical skin depth δ, appropriate for the conductivity perpendicular to the filaments, the losses are calculated for an applied magnetic field transverse to the wire axis in the case of (i) a uniform field ($\sqrt{2}\ R_0/\delta < 1$, $L/2\pi\delta < 1$), (ii) shielding from surface currents ($\sqrt{2}\ R_0/\delta < 1$, $L/2\pi\delta > 1$), and (iii) skin effect ($\sqrt{2}\ R_0/\delta > 1$). Losses are also calculated for the case of a transport current in no applied field. The model can be used in more general cases and has the virtue of giving precise results with a minimum of auxiliary postulates. (auth)

25461 AC LOSS IN A TWISTED FILAMENTARY SUPERCONDUCTING WIRE. II. Carr, W.J. Jr. (Westinghouse Research Laboratories, Pittsburgh, Pennsylvania 15235). J. Appl. Phys. 45: No. 2, 935-938 (Feb 1974).

Hysteresis losses in a twisted filamentary superconducting wire are calculated for various cases corresponding to complete penetration of the magnetic field into the wire, shielding of the field by the supercurrents, and shielding due to eddy currents. In general, the wire may be divided into two regions; an outer saturated layer which tends to behave at the higher frequencies like a solid superconductor and the interior where the average parallel electric field vanishes and the wire behaves like a collection of individual filaments. (auth)

25462 PER-UNIT REACTANCES OF SUPERCONDUCTING SYNCHRONOUS MACHINERY. Kirtley, J. L. Jr. (Massachusetts Inst. of Tech., Cambridge). IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst.; PAS-92: No. 4, 1316–1320(1973).

Because superconducting machines lack well defined magnetic circuits and air gaps, some per-unit normalization methods used for conventional machines are not satisfactory. Six possible ways of normalizing the impedances of air-core machines, illustrating the processes with data from an experimental air core machine are presented. It is found that a commonly used per-unit system may be used with certain modifications. (auth)

25463 MIT–EEI PROGRAM ON LARGE SUPERCONDUCTING MACHINES. Kirtley, J. L. Jr. (Massachusetts Inst. of Tech., Cambridge); Smith, J. L. Jr.; Thullen, P.; Woodson, H. H. IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst.; PAS-92: No. 4, 1282-1286(1973).

Progress is reported on the program at MIT to demonstrate the feasibility and potentials for the application of superconductors in the rotating field windings of large central station synchronous generators. A brief history of the program and a synopsis of previously reported results are given. The second experimental machine (that will have a rating of about 2 MVA) is described. (auth)

PHYSICS (NUCLEAR)

25464 NUCLEAR PHYSICS AS A SCIENCE: EXPERIMENTAL. Heymann, G. Tegnikon; 21: No. 2, 20-23(Jun 1972). (In Afrikaans).

From symposium on the future of nuclear physics in South Africa; Pretoria, South Africa (5 Nov 1971).

The author gives a brief survey of the outstanding experimental problems which ought to enjoy attention in the future in South Africa. These were Fermi surfaces, techniques to determine the magnetic moment of the g-factor of states with very short lives, cycles, magnetic moments, heavy ions and fundamental principle in general. (INIS)

25465 THEORETICAL NUCLEAR PHYSICS AS A SCIENCE. Engelbrecht, C. A. Tegnikon; 21: No. 2, 23-26(Jun 1972). (In Afrikaans).

From symposium on the future of nuclear physics in South Africa; Pretoria, South Africa (5 Nov 1971).

The author analyses the challenges and problems in each of the most important branches of theoretical physics. He then points out two general directions, viz. astrophysics and biophysics, to which more attention could be given in South Africa. (INIS)

25466 REVIEW OF NUCLEAR PHYSICS AS A SCIENCE. Sellschop, J. P. F. Tegnikon; 21: No. 2, 19-20(Jun 1972). (In Afrikaans).

From symposium on the future of nuclear physics in South Africa; Pretoria, South Africa (5 Nov 1971).

The author gives a definition of science and then proceeds to show how nuclear physics has developed as a science. The future of nuclear physics in South Africa will depend on the support of colleagues in the other scientific disciplines and on effective international interaction. (INIS)

25467 NUCLEAR PHYSICS. Bowler, M. G. International Series of Monographs in Natural Philosophy. Volume 53. New York; Pergamon Press (1973). 429p.

This is a textbook on low-energy nuclear physics designed for upper-division undergraduates. It contains little on experimental techniques and nothing on the interaction of radiation with matter. The Fermi Golden Rule runs like a thread through the entire book. Chapter 1 is primarily concerned with nuclear structure at a fairly basic level; the collective model is not included. Chapter 2 deals with spin and static electric and magnetic moments, approached from the point of view of quantum mechanics rather than the vector model. Chapter 3, on nuclear decay, treats both electromagnetic and β decay through quantum mechanics, but without formal field theory. Chapter 4, on the theory of nuclear reactions, discusses the concepts of cross section and of resonance in considerable detail. Chapter 5 is concerned with self-sustaining nuclear reactions; it deals with the nuclear physics of the fission reactor, the nuclear aspects of stellar physics, and the problems of devising a thermonuclear power plant. Chapter 6 discusses the subject of isospin in detail, its relation with charge independence in low-energy nuclear physics, and the extension of the original concept to pion physics and the physics of strange particles. (RWR)

25468 DEVELOPMENT OF NUCLEAR PHYSICS. Perfilov, N. A. (Inst. of Radium, Leningrad). Isotopenpraxis; 9: No. 11/12, 396-402(1973). (In German).

A capsule history of developments in nuclear physics at the Institute over the last fifty years is given. Particular attention is devoted to the method of nuclear emulsions and the study of nuclear reactions through the interaction of high-energy particles with heavy nuclei. Nuclear fission with negative pions and protons and fragmentation are included in the latter section. (RWR)

Neutron Interactions with Matter

Refer also to abstracts 24207, 25859, and 25860.

25469 (ANL-8052) CONSTRUCTION OF A FINITE ELEMENT APPROXIMATION WHICH CROSSES MATERIAL INTERFACES. Leaf, G. K.; Lindeman, A. J.; Kaper, H. G. (Argonne National Lab., Ill. (USA)). Jan 1974. Contract W-31-109-eng-38. 24p. Dep. NTIS $3.25.

Finite element approximations are constructed for the neutron transport and diffusion equations in two dimensions (Cartesian geometry), in which it is assumed that the material parameters are piecewise constant on each mesh triangle. (auth)

25470 (AWRE-O-42-73) FORTRAN IV VERSION OF THE AWRE ONE-DIMENSIONAL MULTIGROUP NEUTRON TRANSPORT S_n PROGRAM STRAINT. Dugan, K.; Price, J. A. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Dec 1973. 95p. Dep. NTIS (U. S. Sales Only) $6.75 UK £ 2.

The one-dimensional multigroup neutron transport S_n program STRAINT was originally written in S_2 FORTRAN (a dialect of FORTRAN 2) by R. D. Wade for the IBM 7030. It has recently been translated into FORTRAN IV for use on the IBM 360 and 370 machines. This report describes in detail the FORTRAN IV version of the program, its capabilities, and operating instructions. (18 figures, 3 tables) (auth)

25471 (AWRE-O-56-73) GUIDE TO GALAXY 3*. Part 2. Price, J. A. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Jan 1974. 84p. Dep. NTIS (U.S. Sales Only) $6.25. UK £1.50.

GALAXY 3* is a system of programs written in FORTRAN IV language for use with the IBM 370/165. Input data from the UKAEA Nuclear Data Library are processed to give group-averaged neutron cross sections and other quantities required when the time dependent neutron transport equation is solved by multi-group methods. The data are processed in two stages using GALAXY 3* Part 1 (AWRE Report O 40/73) and Part 2. The output facilities of Part 2 are exceedingly flexible and enable a wide range of editing operations to be carried out both on the output of Part 1 and on the existing sets of group cross sections on magnetic tapes or cards. (UK)

25472 (CONF-740104-4) REMARKS ON THE THEORY OF FAST NEUTRON SPUTTERING. Robinson, M. T. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. 10p. Dep. NTIS $3.00.

From surface effects in controlled thermonuclear fusion devices and reactors meeting; Argonne, Illinois, USA (10 Jan 1974).

Theoretical estimates of neutron sputtering yields are in serious disagreement with experiment, unlike the situation with ion sputtering. Possible reasons for the discrepancy are sought without success. It is shown that chunk ejection by neutrons is not due to single neutron events nor to the dynamic interference of cascades. The need for more complete experimental data to guide development of the theory is emphasized. (auth)

25473 (COO-3058-39, pp 40-46) MEASUREMENT AND ANALYSIS OF FAST AND INTERMEDIATE NEUTRON SPECTRA IN A SODIUM ASSEMBLY. Mallen, A. N.; Kaushal, N. N.; Malaviya, B. K.; Gaerttner, E. R. [nd].

In linear accelerator project. Annual technical report, October 1, 1972–September 30, 1973.

25474 (IA-1287) MULTIDIMENSIONAL NUMERICAL TRANSPORT BY THE METHOD OF CHARACTERISTICS. Finkelstein, L.; Segev, M. (Israel Atomic Energy Commission, Tel Aviv). Aug 1973. 30p. Dep. NTIS (U. S. Sales Only) $3.50.

Solution of the neutron transport equation along the characteristics enables the use of simple one-dimensional splines for the differential part of the equation. Partition of the surface of the direction sphere to six equal areas enables a simple cubature formula in the integral part of the equation. Simple variants of the method are examplified on theoretical one-dimensional problems and on critical experimental spheres and cylinders. (auth)

25475 (IFA-FR-106-1973) APPLICATION OF LIE SERIES TO RESOLVE THE TIME DEPENDENT BOLTZMANN EQUATION IN THE DIFFUSION APPROXIMATION. Cristea, G. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 24p. Dep. NTIS (U.S. Sales Only) $3.25.

The Lie series method is a good one to use in nuclear reactor theory because it avoids the difficulties that appear in the bad convergence of Bessel functions with large values of the argument in the solution of the diffusion equation in cylindrical geometry. The calculus of first-order differential equations using Lie series is discussed. This is followed by the derivation of the multi-group equation system in a form that can be solved by computer. A flow chart for such a program is given. (5 figures) (RWR)

25476 (UCRL-50400(Vol. 11)) INTEGRATED SYSTEM FOR PRODUCTION OF NEUTRONICS AND PHOTONICS CALCULATIONAL CONSTANTS. Volume 11. Experimental Data, Indexes, and Techniques of Obtaining a Selected Set of Neutron Resonance Parameters. Gyulassy, M.; Howerton, R. J.; Perkins, S. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 May 1972. Contract W-7405-eng-48. 474p. Dep. NTIS $25.75.

A tabulation is presented of 52,000 experimental resonance parameters, together with appropriate indexes and bibliographic citations. These materials were contained in the LLL Experimental Neutron Cross Section Library as of May 1, 1972. Techniques used to obtain a selected set of resolved and unresolved resonance parameters from the compilation are described. (auth)

25477 LINEAR INTEGRAL TRANSFORMATIONS GENERATED BY THE THREE-DIMENSIONAL NEUTRON TRANSPORT KERNEL. Boffi, V.C.; Spiga, G. (Laboratorio di Ingegneria Nucleare dell'Università di Bologna, Bologna, Italy). J. Math. Phys. (N.Y.) 14: No. 12, 1913-1917 (Dec 1973).

Two theorems are established by which the theory of linear integral transformations in a Lebesgue space $L_p(D)$, $p \geq 1$, can be appropriately extended to solve linear integral equations with kernel of nonfinite double norm with respect to the considered $L_p(D)$. An application of these theorems to a physical problem of three-dimensional neutron transport theory is illustrated. (auth)

25478 MOLECULAR FLOW OF ULTRACOLD NEUTRONS THROUGH LONG TUBES. Berceanu, I.; Ignatovich, V. K. (Joint Inst. for Nuclear Research, Dubna, USSR). Vacuum; 23: No. 12, 441-445(Dec 1973).

Monte Carlo calculations have been performed for the transmission probability of cylindrical neutron guides and for the angular distribution of neutrons leaving the guide, the directions of motion of entering neutrons being assumed to obey the cosine law. Specular reflections are supposed to occur at the guide walls. Analytical formulae suitable for long tubes have been obtained. It is shown that the directions of propagation of neutrons at the exit are distributed strongly in a direction parallel to the tube axis. (auth)

25479 MIXED ENERGY-GROUP, ENERGY-POINT FORMALISM FOR NEUTRON SLOWING-DOWN PROBLEMS. Beynon, T. D.; Dyer, M. F. (Univ. of Birmingham, Eng.). J. Phys., D (London); 7: No. 2, 334-344(21 Jan 1974).

An accurate alternative method to energy-multigroup theory for slowing-down problems is considered in which a particular energy range is represented by discrete energy points while the larger part of the energy range is treated by groups. Applications of the technique are made for homogeneous iron–sodium and uranium–graphite mixtures, and for two-region cells composed of these materials. It is demonstrated that, by suitable distribution of the energy points within the selected energy range, reaction rates and their temperature coefficients can be predicted with better accuracy than the conventional multigroup method of treating the energy range as a single group. (auth)

25480 ENERGY-DEPENDENT NEUTRON TRANSPORT IN TWO ADJACENT MEDIA. I. Rajamaeki, M. (Helsinki Univ. of Tech., Otaniemi, Finland). Acta Polytech. Scand., Phys. Nucl. Ser.; No. 91, 1-31(1972).

The singular eigenmode technique is applied to energy-dependent two-media problems using degenerate expansions as the scattering kernels. Complete procedure for determination of the expansion coefficients of the eigenmodes is given. The exact treatment of the energy-dependent total cross sections allows one to obtain Fredholm equations which are more appropriate to computation than those in the corresponding multigroup scheme. After an approximation of the scattering kernels, the developed method is exact, and it can be considered useful from the viewpoint of computation. (auth)

25481 LONGPOL 2: ANALYSIS OF SPIN-FLIP AND NON-SPIN-FLIP NEUTRON SCATTERING. Ahmed, N.; Campbell, S. J.; Hicks, T. J. (Monash Univ., Clayton, Australia). J. Phys., E (London); 7: 199-204(Mar 1974).

A theoretical analysis and experimental measurements of spin-flip and nonspin-flip neutron scattering from nuclear spin and magnetic systems are described. The suitability of polycrystalline iron as a polarization filter for long wavelength neutrons has been tested using the double transmission effect τ_D. This effect has been measured as a function of neutron wavelength and at different thicknesses of iron filters. For neutrons with a wavelength of 0.36 nm and for an iron thickness of 6 nm, for which depolarization of the neutron beam is small, τ_D is about 22%, corresponding to a neutron polarization of 33%. The nuclear spin scattering from samples of vanadium and hydrogen in water measured at 0.36 nm is found to occur as $^2/_3$ spin-flip and $^1/_3$ nonspin-flip, in agreement with the theory. The paramagnetic scattering from MnO, MnF_2 and 5 at. % Cu–Mn has also been measured at 0.36 nm, and it is found that for MnO and MnF_2 not all of the magnetic scattering is observed as spin-flip scattering. This is explained by the inelasticity of 0.36 nm neutron scattering from these systems with critical temperatures 122°K and 77°K, respectively. Good agreement between measured and calculated values of spin-flip and nonspin-flip cross sections is obtained for scattering from the Cu–Mn specimen with a critical temperature of the order of 10 to 20°K. (auth)

25482 ITERATED SEQUENTIAL TRANSPORT APPROXIMATION FOR ANISOTROPIC SPECTRAL MOMENTS. Gibbs, D. C.; Becker, M.; Malaviya, B. K. (Rensselaer Polytechnic Inst., Troy, NY). Nucl. Sci. Eng.; 53: No. 3, 327-329(Mar 1974).

An improved procedure for generating anisotropic weighting spectra is derived. This procedure leads to differences from previous methods in the presence of strong resonance structure. (1 table) (auth)

25483 TRANSPORT ANALYSIS OF MEASURED NEUTRON LEAKAGE SPECTRA FROM SPHERES AS TESTS OF EVALUATED HIGH-ENERGY CROSS SECTIONS. Bogart, D.; Shook, D. F.; Fieno, D. (Lewis Research Center, Cleveland). Nucl. Sci. Eng.; 53: No. 3, 285-303(Mar 1974).

Integral tests of evaluated ENDF/B high-energy cross sections were made by comparing measured and calculated neutron leakage flux spectra from spheres of various materials. An Am–Be(α,n) source was used to provide fast neutrons at the center of the test spheres of beryllium, polyethylene, lead, niobium, molybdenum, tantalum, and tungsten. The absolute leakage flux spectra were measured in the energy range from 0.5 to 12 MeV by using a calibrated NE-213 liquid scintillator neutron spectrometer. Absolute calculations of the spectra were made by using Version-III ENDF/B cross sections and an S_n discrete-ordinates multigroup transport code. Generally excellent agreement was obtained for beryllium, polyethylene, lead, and molybdenum, and good agreement was observed for niobium although discrepancies were observed for some energy ranges. The poor comparative results obtained for tantalum and tungsten are attributed to unsatisfactory nonelastic cross sections. The experimental sphere leakage flux spectra are tabulated and serve as possible benchmarks for these elements, against which reevaluated cross sections may be tested. (17 figures, 4 tables) (auth)

25484 FORWARD-ADJOINT COUPLING AS A MEANS OF SOLVING THREE-DIMENSIONAL DEEP-PENETRATION TRANSPORT PROBLEMS. Slater, C. O.; Robinson, J. C. (Univ. of Tennessee, Knoxville). Nucl. Sci. Eng.; 53: No. 3, 332-337 (Mar 1974).

The solution of a special type of deep penetration problem is obtained by coupling a deep-penetration forward calculation with a localized adjoint calculation. The system on which the calculation is performed consists of a target far removed from a radiation source. In the absence of the target, the system geometry is simple (i.e., one- or two-dimensional). The problem is to compute some effect of interest (e.g., reaction rate, flux, etc.) within the target. The problem solution consists of a source-centered calculation of the radiation field with the target absent, a target-centered adjoint calculation on the system with the source absent, and a coupling of the above two calculations. The technique was applied to fissile and non-fissile targets located at various distances from and having various orientations with respect to a unit isotropic point fission neutron source in an infinite air medium. (3 tables) (auth)

25485 TRANSPORT EQUATION IN AN ACCELERATED MATERIAL, LEGENDRE MOMENTS, AND A DIFFUSION APPROXIMATION. Wienke, B. R. (Los Alamos Scientific Lab., NM). Nucl. Sci. Eng.; 53: No. 3, 329-332(Mar 1974).

The Boltzmann equation in an accelerated medium is described; and the Legendre moments of the equation, formulated in velocities relative to that medium, are obtained for one-dimensional plane and spherical geometries. The accelerated medium effectively introduces additional velocity-dependent terms into the usual moment equations. The P_n scheme is suggested for the coupled-channel equations, and a low-order diffusion approximation accounting for the acceleration of the medium is proposed. (auth)

25486 DIRECTORY TO NEUTRON CROSS-SECTION DATA: DECEMBER 1973. Way, K.; Cafver, K. (Duke Univ., Durham, NC). At. Data Nucl. Data Tables; 12: No. 6, 585-592(15 Dec 1973).

An annotated list of sources of information in the neutron cross-section field is presented. (auth)

Nuclear Properties and Reactions, A ≦ 5

Refer also to abstract 25587.

25487 (AERE-R-7600) NEUTRON ENERGY SPECTRUM AT 0° FROM THE REACTION $d(^9Be,^{10}B)n$ FOR A DEUTERON ENERGY OF 1.8 MeV. Clements, P. J. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Dec 1973. 12p. Dep. NTIS (U.S. Sales Only) $3.00. UK 50 pence.

The neutron energy spectrum at 0° from the reaction $d(^9Be,^{10}B)$ at 1.8 MeV has been measured. The neutrons were produced by bombarding a water-cooled beryllium target with deuterons from the Harwell 5 MeV Van de Graaff accelerator and were detected by a ^{6}Li semiconductor sandwich spectrometer. The spectrum has a large double peak below 1 MeV and a high energy component extending to ~7 MeV. (auth)

25488 (CEA-CONF-2459) NEW EXPERIMENTAL RESULTS FROM SACLAY AND SOME PERSPECTIVES OF NUCLEAR INVESTIGATIONS WITH ELECTRON LINAC. Tzara, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91, Gif-sur-Yvette (France)). [nd]. 21p. (CONF-721215-3). Dep. NTIS (U.S. Sales Only) $3.25.

From seminar on electromagnetic interactions of nuclei at small and medium energies; Moscow, USSR (Dec 1972).

The Saclay electron linac and its associated equipment were designed for studies of nuclear and elementary particles with electrons, photons, pions, and muons. Some of the experiments carried out are briefly discussed. The nuclear spectroscopy of ^{52}Cr and ^{92}Mo by electron scattering at 209 MeV showed that inclusion of one-particle–one-hole excitations in the configuration space improves the theory. Preliminary data on the residual energy spectrum from electron scattering on quasi-free protons in ^{12}C at 497 MeV are given; peaks located at the discrete states of the residual nucleus show clearly, and the spectrum becomes continuous above the threshold for particle emission. Cross sections for the two-body photodisintegration of ^{3}He and ^{4}He between 150 and 350 MeV are shown; no prominent structure is seen in either case. The final experiment discussed is the photoproduction of π^{-} + p on ^{4}He. At low recoil momentum the photoproduction cross section is well described by the impulse approximation, but at high recoil momentum the independent particle model no longer holds. The data presented indicate an anomaly in the photoproduction cross section. (7 figures) (RWR)

25489 (JINR-P1-7628) ELASTIC $\pi^{\pm}$ MESON SCATTERING BY ^{4}He AT 68 AND 154 MeV. Al'bu, M.; Beshliu, T.; Garfagnini, R.; Kulyukin, M. M.; Lyashenko, V. I.; Mihul, A.; Nichitiu, F.; Piragino, G.; Pontecorvo, G. B.; Falomkin, I. V.; Shcherbakov, Yu. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Differential cross sections for an elastic π^{+}-and π^{-}-meson scattering by ^{4}He are measured with the aid of a He streamer chamber of high pressure. The phase shift analysis is made, and a set of phases is obtained. The results are compared with the previously obtained data. (auth)

25490 CONTRIBUTIONS TO THE ELECTROMAGNETIC FORM FACTORS OF THE DEUTERON FROM ISOBAR CONFIGURATIONS. Arenhoevel, H. (Univ., Mainz); Miller, H. G. Z. Phys.; 266: No. 1, 13-20(1974).

A nonrelativistic calculation of elastic electron–deuteron scattering has been performed in which the effects arising from nucleon polarization have been systematically investigated. These effects have been taken into account by admixing isobar configurations into the deuteron wave function. Explicit expressions for the various contributions to the respective deuteron form factors have been given. At higher momentum transfers inclusion of the isobar configurations leads to a substantial increase in the form factors, which qualitatively appears to account for at least some of the discrepancies between theory and experiment. (2 figures, 3 tables) (auth)

25491 EFFECTS OF EXCHANGE AND FINAL-STATE INTERACTIONS IN THE REACTIONS ^{2}H(^{3}He,^{3}H p)p AND ^{2}H(^{3}He,^{3}He p)n. Warner, R. E. (Oberlin Coll., OH); Gottlieb, S. A.; Ball, G. C.; Davies, W. G.; Ferguson, A. J.; Forster, J. S. Nucl. Phys., A221: No. 3, 593-607(1974).

Absolute coincidence cross sections for the ^{2}H(^{3}He,^{3}He p)n and ^{2}H(^{3}He,^{3}H p)p reactions were measured at E_{He} = 35.9 MeV. Spectra dominated by the nucleon–nucleon final-state interaction (FSI) are fitted by a fully antisymmetrized PWBA theory which includes the effects of FSI in all its matrix elements. Previously reported 26.8-MeV data showing both FSI and quasi-elastic scattering (both with and without charge exchange) are also fitted by the theory, which qualitatively describes the shapes of all these spectra and the ratios of the cross sections for the various processes. Predictions of Watson–Migdal theory are fitted to the FSI spectra, and differences between the two theories are analyzed. (7 figures) (auth)

25492 DESCRIPTION FOR ELASTIC α–d SCATTERING OBTAINED FROM A MICROSCOPIC CALCULATION FOR THE ^{6}Li SCATTERING SYSTEM. Hackenbroich, H. H.; Heiss, P.; Le-Chi-Niem. (Univ., Cologne). Nucl. Phys., A221: No. 3, 461-474(1974).

Scattering states of the ^{6}Li system are calculated in the cluster-model multichannel-reaction scheme, starting from a carefully chosen effective nucleon–nucleon potential which contains Coulomb, central, spin–orbit, and tensor parts. In addition to α–d and ^{3}He–^{3}H channels, α–n–p break-up channels are considered in the sequential decay approximation. It is shown that only the inclusion of these channels leads to quantitative agreement between theoretical and experimental values for the α–d elastic cross sections and polarizations. (9 figures, 1 table) (auth)

25493 SPACE SYMMETRY IN LIGHT NUCLEI. II. SU(4) Isospin–Spin Averages. Hag, R. U.; Parikh, J. C. (Physical Research Lab., Ahmedabad, India). Nucl. Phys.; A220: No. 2, 349-366(1974).

The validity of the Wigner supermultiplet scheme in the d-s shell is investigated for nuclei with neutron excess using the spectral distribution methods of French. Averages of the Hamiltonian H and H^{2} over states belonging to a definite SU(4) symmetry, isospin and spin are used to determine ground state energies and low lying spectra of nuclei. Intensities of various irreducible representations of SU(4) near the ground state are evaluated and these provide a measure of symmetry breaking. It is found that the symmetry in nuclei with neutron excess is no worse than that for the lowest isospin ones. The results obtained are compared with the Franzini–Radicati mass formula. (auth)

25494 PRODUCTION AND ABSORPTION OF PHOTOPIONS IN NUCLEI ^{6}Li, ^{7}Li, ^{9}Be. Goncharov, N. V.; Tonapetyan, S. G.; Khvorostyan, V. M. (Physical-Technical Inst., Kazan). Yadern. Fiz.; 19: No. 1, 21-24(Jan 1974). (In Russian).

Results are presented of study of yields of charged pions and protons at interaction of photons having E_{γ}^{max} = 400 MeV with nuclei ^{6}Li, ^{7}Li, ^{9}Be. The particles, emitted under the angle $\theta_{l.s.}$ = 90 ± 7°, were registered in a freon bubble chamber in the kinetic energy ranges E_{π} = 30 – 120 MeV and E_{p} = 70 – 240 MeV. The results of the investigation are considered in view of effect of the cluster structure of the light nuclei on the probability for the pions produced inside the nuclei to be absorbed. (auth)

25495 REACTION (p,n) ON Li ISOTOPES AND CHARGE-EXCHANGE PART OF THE EFFECTIVE TWO-PARTICLE INTERACTION. Arifkhanov, U. R.; Gulyamov, M.; Islamov, B. I.; Kayumov, M.; Ertashov, E. (Inst. of Nuclear Physics, Tashkent). Yadern. Fiz.; 19: No. 1, 25-27(Jan 1974). (In Russian).

Differential cross sections of the reactions ^{7}Li(p,n_{0})^{7}Be and ^{6}Li(p,n_{0})^{6}Be were measured at the proton energies of 14.9 and 17.8 MeV by means of proton cyclotron at Nuclear Physics Institute of UzbSSR Academy of Sciences. From analysis of the integral cross sections of the reactions ^{7}Li(p,n_{0})^{7}Be and ^{7}Li(p,n_{1})^{7}Be (0.43 MeV) at E_{p} = 17.8 MeV the ratio is obtained of parameters of the charge-exchange part of effective two-particle interaction $V_{\sigma\tau}/V_{t}$ = 0.83 ± 0.16. (auth)

25496 THRESHOLD ELECTRODISINTEGRATION OF THE DEUTERON CAUSED BY BACKWARD SCATTERING OF ELECTRONS. Smirnov, S. A.; Trubnikov, S. V. (Inst. of Mathematics, Moscow). Phys. Lett.; 48B: No. 2, 105-108(21 Jan 1974).

Using a new relativistic integral representation for the matrix element of electromagnetic current in terms of experimental phase shifts alone (representation of Shirokov RS) the cross section of the threshold electrodisintegration of the deuteron caused by backward scattered electrons is calculated for the S-wave deuteron in the interval of the four-momentum transfers squared $0.16 \le q^{2} \le 5$ fm^{-2}. Nucleon-nucleon interaction in the deuteron and the final state interaction (FSI) are taken into account in a unified manner and exactly. The effects of the meson exchange currents (MEC) and the inelastic n-p channels are neglected. The calculated cross section coincides with the experimental one. (auth)

25497 SENSITIVITY OF n–d SCATTERING STATES TO THE NUCLEON–NUCLEON INTERACTION. Doleschall, P. (Univ. of Helsinki). Nucl. Phys.; A220: No. 3, 491-504(1974).

A new set of separable P-wave interactions and rank-2 tensor forces were constructed and applied in three-body calculations for n–d elastic scattering at E_{n} = 22.7 MeV. A significant sensitivity of the polarizations to the different tensor forces and to the $^{3}D_{2}$ interaction was found. (auth)

25498 OFF-SHELL EFFECTS IN SCATTERING FROM THE DEUTERON. Sparrow, D. A. (Massachusetts Inst. of Tech., Cambridge); Walker, J. F.; Gerace, W. J. Phys. Lett.; 48B: No. 3, 186-190(4 Feb 1974).

A simple model for scattering from a deuteron is studied. Within this model exact coupled-channel solutions, including all multiple-scattering-series terms, are obtained for a fixed separation of the two scattering potentials. These solutions are compared with approximations which involve a spherically averaged or nonoverlapping potential. The results indicate that the nonnegligible contributions arising from the overlapping potential region can be adequately reproduced by a combination of simple approximations, this facilitates calculations of scattering from a more physical deuteron model. (auth)

25499 CROSS SECTION CALCULATIONS FOR THE PHOTO BREAK-UP REACTION $^6Li(\gamma,\tau)^3H$. Clement, D.; Zahn, W. (Univ., Tuebingen, Ger.). Phys. Lett.; 48B: No. 3, 183-185 (4 Feb 1974).

The photonuclear reaction $^6Li(\gamma,\tau)^3H$, which contributes appreciably to the total nuclear photoeffect for photon energies between 16 and 35 MeV, is studied in the framework of the unified theory of nuclear reactions based on cluster representations. (auth)

25500 FIVE-NUCLEON SYSTEM ABOVE THE THREE-PARTICLE THRESHOLD. Schroeder, H. (Univ., Freiburg i. B.); Kern, K. K.; Fick, D. Phys. Lett.; 48B: No. 3, 206-208(4 Feb 1974).

Compound-nucleus states in ^5Li and ^5He were investigated with the $^3He(d,p)pt$ and $^3H(d,n)pt$ three-particle reactions. The observed $J^\pi = 3/2^-$ states ($E_x \approx 20$ MeV) can be understood, in analogy to the ground states of the A = 5 system, by coupling a $p_{1/2}$ nucleon to the first 0^+ excited state of ^4He. (auth)

25501 QUASI-ELASTIC MECHANISM OF THE REACTION d(p,2p)n. Meboniya, J. V. (Tbilisi State Univ., USSR). Phys. Lett.; 48B: No. 3, 196-198(4 Feb 1974).

The problem of the validity of the quasi-elastic mechanism of the reaction d(p,2p)n in the low-energy region (20−50 MeV) is studied. While estimating the effect of multiple scattering, it is shown that the condition of quasi-elasticity holds sufficiently well in all the considered cases under the assumption of peripheral collision of counted particles (the cutoff method). The dependence of the cutoff radius, R_0, on the energy of incident particles, E_0, is discussed. (auth)

25502 LONGITUDINAL POLARIZATION TRANSFER IN THE $T(\vec{p},\vec{n})^3He$ REACTION. Jarmer, J. J.; Martin, J. C.; Ohlsen, G. G.; Salzman, G. C.; Simmons, J. E. (Los Alamos Scientific Lab., NM). Phys. Lett.; 48B: No. 3, 215-217(4 Feb 1974).

The longitudinal polarization of neutrons was measured for the reaction $T(\vec{p},\vec{n})^3He$ with the incident proton beam longitudinally polarized. Measurements were performed at 0° for proton energies from 4 to 15 MeV and an angular distribution was measured at 10 MeV. The data determine the polarization transfer coefficient $K_z^{z'}$, which is equivalent to the Wolfenstein A′ parameter for nucleon−nucleon scattering. The quantity $K_z^{z'}$ at 0° increases from about 0.3 at 3 MeV incident energy to 0.9 at 9 MeV, and then decreases to 0.5 at 15 MeV. The data are compared with R-matrix calculations which reproduce the qualitative shape of the data at 0° and the angular distribution at 10 MeV. (auth)

Nuclear Properties and Reactions, $6 \leq A \leq 19$

Refer also to abstracts 25236, 25351, 25488, 25493, 25527, 25536, 25544, 25581, 25646, 25652, and 25681.

25503 (AD-763895) CROSS SECTIONS FOR FORWARD-ANGLE ELASTIC SCATTERING OF 7 TO 10 MeV NEUTRONS FROM CARBON, NITROGEN, AND OXYGEN. Bucher, W. P.; Hollandsworth, C. E.; Niiler, A.; McNatt, D.; Youngblood, J. E. (Ballistic Research Labs., Aberdeen Proving Ground, Md. (USA)). Jun 1973. 23p. (BRL-1652). NTIS $3.00.

Absolute differential cross sections for the elastic scattering of 7.40-, 7.55-, 8.00-, 8.55-, 9.00-, and 9.50-MeV neutrons from carbon, nitrogen, and oxygen in the angular range from 2.5 degrees to 15 degrees were determined. Measurements were made relative to the scattering from lead by use of a special-purpose collimator. The cross section scale was then established by absolute measurements for lead in a ring geometry experiment. The results for nitrogen are consistent with recent measurements at other laboratories, which suggest that the discrepancy in previous nitrogen cross section data around 7−8 MeV neutron energy arose from an underestimate of the elastic scattering cross section. The data represent the first direct measurements of neutron scattering cross sections for light elements at very small scattering angles. (auth)

25504 (ANU-P-582) POSSIBLE RESONANCE ANOMALIES IN THE $^{16}O + ^{12}C$ REACTION. Branford, D.; Newton, J. O.; Robinson, J. M.; Nagorcka, B. N. (Australian National Univ., Canberra. Dept. of Nuclear Physics). 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

A strong correlation was observed between the 0° and 180° excitation functions for the $^{12}C(^{16}O,\alpha)^{24}Mg$ reaction leading to the 13.2 MeV 8^+ level. The possibility that this is due to exciting intermediate structure peaks at $E_{cm} = 13.7, 14.7, 16.0$, and 18.0 MeV, or preferential excitation of even or odd angular momenta in the entrance channel, is discussed. (2 figures, 1 table) (auth)

25505 (COO-1195-283) GLAUBER−DECK MODEL FOR 3π PRODUCTION ON NUCLEI. Cutler, R. T. (Illinois Univ., Urbana (USA). Dept. of Physics). 1973. Contract AT(11-1)-1195. 35p. Dep. NTIS $3.75.

A Glauber theory is developed for the reaction $\pi^-A \rightarrow \pi^+\pi^-\pi^-A$, where A is a nucleus, using a Reggeized Deck amplitude for 3π production on a nucleon. A simple absorption amplitude for the 3π system is proposed, and the resulting amplitude calculated for carbon at 15.1 GeV/c, using a Monte Carlo approach. Alternative absorption schemes are discussed, including a multi-impact parameter model. The reaction $\pi^-C \rightarrow \pi^+\pi^-\pi^-C^*_{4.44}$ is also calculated using an effective one particle excitation parametrization. (auth)

25506 (JINR-P15-7515) STUDY OF THE REACTION $^{15}N(^3He,\alpha)^{14}N$. Osetinskii, G. M.; Tyke, Ya.; Fryshchin, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

In the energy range of 1.98 to 4.2 MeV the differential cross sections of the $^{15}N(^3He,\alpha)^{14}N$ reactions for the $\alpha_0\alpha_1\alpha_2$ groups at 45, 90 and 135° and for the $\alpha_3\alpha_4$ groups at the angles of 90 and 135° were measured. The angular distributions of this reaction are measured for the $\alpha_0\alpha_1$ groups. A possibility is considered to describe the obtained results using the distorted-wave Born approximation taking into account the compound nucleus mechanism by the Hauser−Feshbach method. (auth)

25507 (JINR-P15-7650) ANALYSIS OF THE CROSS SECTIONS OF THE REACTION $(^3He,p)$ ON ^{12}C BY THE RESONANCE THEORY. Shirmer, G.; Krivopustov, M. I.; Shul'ts, G.; Eler, G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The differential cross sections of the $^{12}C(^3He,p)^{14}N$ reaction are analyzed by the resonance theory in the energy region from 2.20 to 3.61 MeV. For the first time there were determined the spins and parities of three resonances. The energy values and those of total widths of the resonance states of a compound ^{15}O nucleus were made more accurate. The existence of the resonance $1/2^-$ at an energy of 2.87 MeV is considered. (auth)

25508 NUCLEON−^6Li ELASTIC SCATTERING. Laskar, W.; Remaud, B. (Nantes Univ., France). J. Phys. (Paris); 34: No. 10, 783-790(Oct 1973). (In French).

A nucleon−nucleon potential, with Gaussian shape, is used in the microscopic study of the elastic scattering of nucleons by ^6Li. The ^6Li wave function is completely antisymmetrized: it is extracted from shell-model calculations for nuclei $(1s)^A$ $(1p)^A$. The correlation between nucleons needed to explain the characteristics of ^6Li are introduced by resonating-group methods. The binding energy, the relative energy between α and d, and (with less accuracy) the mean square radius are found in good agreement with experimental results. The calculated phase shifts are in good agreement with those obtained from an analysis of experimental data in the case of p−^6Li. In the study of p−^6Li and n−^6Li, with $S = 3/2$ and $L = 1$, a resonance indicates a ^4P level, the potential used being purely central, and this level lies between the $^4P_{1/2}$ and $^4P_{3/2}$ levels found experimentally. In the n−^6Li case, the phase goes through 90 deg at 10.1 MeV for L = 1 and S = 1/2; it is the $1/2^+$ level, expected by the theory, but not yet located. (FR)

25509 CALCULATED SECONDARY-PARTICLE SPECTRA FROM ALPHA-PARTICLE- AND CARBON-INDUCED NUCLEAR REACTIONS. Gabriel, T. A.; Santoro, R. T.; Bertini, H. W.; Larson, N. M. (Oak Ridge National Lab., TN). Nucl. Sci. Eng.; 53: No. 3, 323-326(Mar 1974).

A newly developed calculational model for nucleus−nucleus collisions was applied to obtain secondary-neutron spectra from 100-MeV/nucleon alpha particles incident on ^{12}C and from 100-MeV/nucleon ^{12}C incident on ^{12}C. These data can be used in estimating shielding requirements for medium-energy heavy-ion machines. Also included is a comparison between a previous model used only for calculating secondary-particle spectra from alpha-particle nuclear reactions and the new, more general nucleus−nucleus collision model. (4 figures, 1 table) (auth)

25510 $^6Li(n,t)^4He$ DIFFERENTIAL CROSS SECTIONS BETWEEN 0.1 AND 1.8 MeV. Overley, J. C.; Sealock, R. M.;

Ehlers, D. H. (Univ. of Oregon, Eugene). Nucl. Phys., A221: No. 3, 573-592(1974).

Absolute triton and α-particle yields from the $^{6}Li(n,t)^{4}He$ reaction were measured at 8 lab angles between 0° and 90° for neutron energies between 0.1 and 1.8 MeV. Incident neutrons with a continuous energy distribution were used, and reaction yields were measured as a function of detected particle energy and the sum of particle-plus-neutron flight times. Yield data were converted to (n,t) c.m. differential cross sections at 16 angles between 0° and 180°. Each of the 25 angular distributions obtained was fitted to a series of Legendre polynomials. The coefficients of the P_0 terms are in excellent agreement with recent total cross section measurements. The behavior of the other coefficients, particularly the coefficients of the P_1 terms in the vicinity of the resonance at $E_n = 247$ keV, will require modifications in previous R-matrix parameterizations of the reaction. (8 figures, 3 tables) (auth)

25511 CROSS SECTION MEASUREMENTS WITH A NEUTRON GENERATOR. Mubarakmand, S.; Ahmad, M.; Anwar, M.; Chaudhry, M. S. (Pakistan Inst. of Nuclear Science and Tech., Rawalpindi). Nucl. Instrum. Methods; 115: No. 2, 345-347 (1974).

A 14.7 MeV neutron beam from a neutron generator has been elastically scattered from a plastic scintillation detector. The scattered neutrons are detected with another detector. The energy of the scattered neutrons can be selected by changing the angle of scattering in a time-of-flight arrangement. Total cross-section measurements are then possible at all energies between 1.7 MeV and 14.7 MeV. (auth)

25512 DETERMINATION OF THE TRUE WIDTH OF PHOTONUCLEAR RESONANCES. Kirkman, R. E.; Koch, R.; Stock, H.; Thies, H. H. (Univ. of Western Australia, Nedlands). Nucl. Instrum. Methods; 115: No. 2, 539-540(1974).

The apparent width of a photonuclear resonance — as measured in a polychromatic gamma experiment — depends on the experimental resolution as well as on truncation errors introduced in the data analysis. It is shown how one can obtain a semi-quantitative upper limit to the true width of the resonance from accurate polychromatic gamma data. (auth)

25513 PION CHARGE-EXCHANGE SCATTERING ON ^{13}C. Reitan, A. (Univ., Trondheim, Norway). Nucl. Phys.; B68: No. 2, 387-396(1974).

The $^{13}C(\pi^{+},\pi^{0})^{13}N$ reaction was re-examined in the framework of the Glauber model in order to take exchanges terms properly into account. Satisfactory agreement with the experiments can only be obtained if one introduces configuration mixing in the nuclear states. (auth)

25514 STRUCTURE, TRANSITION PROBABILITIES, AND THE π^{-} CAPTURE RATES OF THE A = 6 NUCLEI. Vergados, J. D. (Univ. of Pennsylvania, Philadelphia). Nucl. Phys.; A220: No. 2, 259-268(1974).

The energy spectrum, electromagnetic properties, β-decay and π^{-} absorption rates of the A = 6 system are calculated using realistic interactions. The results are in good agreement with experiment and other theories of semileptonic weak processes. Strong π^{-} absorption rates are predicted for the 2^{-} and 3^{-} collective states around 25 MeV. (auth)

25515 HYBRID R-MATRIX–OPTICAL MODEL PARAMETRIZATION OF THE $^{12}C(\alpha,\gamma)^{16}O$ CROSS SECTION. Koonin, S. E.; Tombrello, T. A.; Fox, G. (California Inst. of Tech., Pasadena). Nucl. Phys.; A220: No. 2, 221-232(1974).

The $^{12}C(\alpha,\gamma)^{16}O$ cross section at astrophysical energies was determined from existing $^{12}C(\alpha,\alpha)^{12}C$ and $^{12}C(\alpha,\gamma)^{16}O$ data by means of a "hybrid" R-matrix–optical model method; one obtains an S-factor of $0.08^{+0.05}_{-0.04}$ MeV · b at $E_{cm} = 300$ keV. The E1 γ-ray width of the 9.59 MeV state was determined to be 23 ± 3 MeV. (auth)

25516 MUONUCLEAR ABSORPTION AND THE FACTORIZATION METHOD. Joseph, J. (Institut de Physique Nucleaire de Lyon, Villeurbanne, France); Goulard, B. Can. J. Phys.; 51: No. 22, 2382-2388(15 Nov 1973).

Muon absorption by a nucleus $[\mu^{-} + [Z,A] \rightarrow [Z-1,A]^{*} + \nu_{\mu}]$ is treated in the framework of a factorization method already tested in photonuclear physics. The transition rates to various states 0^{-}, 1^{-}, 2^{-} of the final nucleus $[Z-1,A]^{*}$ and the energy spectra of the subsequent outgoing neutrons are analyzed in the case of ^{16}O and ^{40}Ca (auth)

25517 EFFECTS OF INTERMEDIATE CHANNELS IN ISOSPIN FORBIDDEN REACTIONS. Iachello, F. (Univ. of Groningen, Netherlands); Singh, P. P. Phys. Lett.; 48B: No. 2, 81-83(21 Jan 1974).

It is shown that intermediate channels can significantly contribute to isospin forbidden reactions. The properties of the apparent violation are discussed and experiments suggested to test the validity of the assumptions. The contributions of intermediate stripping channels to the $^{12}C(d,d')^{12}C^{*}(T = 1)$ reaction is estimated. (auth)

25518 ELASTIC SCATTERING OF PROTONS ON ^{9}Be AT $E_p = 6$ TO 7 MeV. Vasil'ev, S. S.; Galakhmatova, B. S.; Gubin, V. B.; Mikhaleva, T. N.; Romanovskii, E. A.; Chuprunov, D. L.; Dem'yanova, A. S.; Nikitina, L. I. (Moscow State Univ.). Yadern. Fiz.; 19: No. 1, 28-31(Jan 1974). (In Russian).

Differential cross section of elastic proton scattering on ^{9}Be nuclei and the polarization were measured at E ~ 6 MeV. Parameters of the optical model are obtained that result in a satisfactory description of the polarization; as for the calculated cross sections, the agreement with the experimental data in the angular region of the forward hemisphere is not obtained. Possible reasons for these disagreements are discussed. (auth)

25519 $(\pi^{+},\pi^{+}p)$ REACTION ON CARBON AT SMALL MOMENTA TRANSFERRED TO THE NUCLEUS AT 60 AND 112 MeV. Gismatullin, Yu. R.; Lantsev, I. A.; Ostroumov, V. I.; Smelyanskii, A. Ya. (Leningrad Polytechnic Inst.). Yadern. Fiz.; 19: No. 1, 45-49(Jan 1974). (In Russian).

The nuclear emulsion method is used to study the $(\pi^{+},\pi^{+}p)$ reaction on carbon at 60 and 112 MeV pion energies. The total reaction cross section is obtained as well as the momentum and angular distributions of the residual nuclei, the angular and energy distributions of protons, the pion scattering differential cross sections. Those distributions are compared with pole calculations and it is concluded that the pole mechanism dominates at small momentum transfers (smaller than 150 MeV/c). (auth)

25520 ROLE OF THE EXCHANGE PROCESSES IN QUASI-FREE DEUTERON KNOCK-OUT REACTIONS. Zhusupov, M. A. (Kazakh State Univ., Alma-Ata, USSR); Magzumov, E. Zh.; Markov, V. I. Phys. Lett.; 48B: No. 2, 84-86(21 Jan 1974).

An estimate of the contribution of the spin-flip knock-out processes in the (p,pd) reaction on ^{12}C and ^{6}Li is carried out and possibilities of observation of such exchange processes in experiments are discussed. (auth)

25521 SEARCH FOR PARITY-NONCONSERVING EFFECTS IN THE $^{12}C(\alpha,\gamma)^{16}O$ REACTION. Bellotti, E.; Fiorini, E.; Negri, P. (Univ., Milan). Lett. Nuovo Cim.; 9: No. 6, 251-255 (9 Feb 1974).

Preliminary results are reported on the reactions $^{4}He + {}^{12}C \rightarrow {}^{16}O^{*} \rightarrow {}^{16}O + \gamma$-rays, where the excited ^{16}O levels are the $(0^{-},0)$ level at (10.952 ± 0.003) MeV and the $(3^{+},0)$ level at (11.080 ± 0.003) MeV. From the analysis of the total difference spectrum the following limits on parity-nonconserving widths were obtained: $\Gamma_{\alpha}(10.952) < 6 \cdot 10^{-4}$ eV, $\Gamma_{\alpha}(11.080) < 5 \cdot 10^{-4}$ eV. (LBS)

25522 EXTENSION OF THE RESONATING GROUP TREATMENT OF COMPOSITE PARTICLE SCATTERING TO THE HEAVY SYSTEM. Horiuchi, H. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 50: No. 2, 529-544(Aug 1973).

A new analytical method of calculating the kernels in the resonating group treatment of the composite particle scattering is presented. It converts the calculations of matrix elements to those in terms of the Slater determinantal wave functions. By this the range of applicability of the resonating group method can be extended to systems heavier than $\alpha + \alpha$ such as $\alpha + {}^{16}O$ and possibly $^{16}O + {}^{16}O$. Since the method treats the lighter particle as a cluster in the valence orbits outside the core of the heavier particle, the correspondence of the resonating group treatment to the continuum shell model is clearly displayed. As an application, kernels in the $\alpha + {}^{16}O$ system are calculated and by using them the validity of the orthogonality condition model in this system is investigated which is originally proposed by Saito in the $\alpha + \alpha$ system. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 23916, 24283, 25493, 25504, 25509, 25511, and 25610.

25523 (ANU-P-585) ALPHA CAPTURE TO THE GIANT DIPOLE RESONANCE. Foote, G. S.; Branford, D.; Weisser, D. C.; Shikazono, N.; Huang, F. C. P. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Dec 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

Cross sections for α-capture to the giant dipole resonances of 1d2s and 1f2p shell nuclei are shown to be in agreement with Hauser–Feshbach calculations. Isospin mixing in ^{28}Si, ^{32}S and ^{40}Ca is discussed. It is shown that α-capture data do not provide a conclusive test for the proposed isosplitting of the ^{60}Ni and ^{42}Ca giant dipole resonances. (auth)

25524 ELECTROMAGNETIC TRANSITION RATES AND VIBRATIONAL MODES IN ^{34}S. Grawe, H.; Koenig, R. (Univ., Freiburg, i.B.). Z. Phys.; 266: No. 1, 41-50(1974).

States in ^{34}S up to 6 MeV excitation energy, populated by the reaction ^{31}P(α,pγ), have been investigated by Doppler shift and line shape analysis and pγ and $\gamma\gamma$ angular correlation measurements. The strengths of electromagnetic transitions between even-parity levels are compared with theoretical predictions of the weak-coupling unified model and the many-particle shell model. The experimental evidence for a weak coupling of the single-particle motion to vibrational modes is discussed. (13 figures, 3 tables) (auth)

25525 EXCITED STATES OF ^{31}P BY MEANS OF THE ^{33}S(d,α)^{31}P REACTION. Teterin, E. D.; Khlebnikov, S. V.; Nemilov, Yu. A.; Romanov, V. S.; Gridnev, K. A. (Leningrad State Univ.). Yadern. Fiz.; 19: No. 1, 11-20(Jan 1974). (In Russian).

Energy spectra and angular distributions of the α particles from the ^{33}S(d,α)^{31}P reaction were measured at E_d = 7.0 MeV. Forty-six levels were observed with excitation energies up to 7.6 MeV. New levels of ^{31}P were found at E_x = 6668 keV and E_x = 7572 keV. It was confirmed that there exist two separate levels near E_x = 5.02 MeV with excitation energies differing less than by 1 keV. The results of the measurements indicate a compound nucleus mechanism of the reaction and good agreement with angular distributions from Hauser–Feshbach theory calculations. The measurements lead to the following J assignments of ^{31}P excited states: $J(2.23) = 5/2$; $J(3.13) = 3/2$; $J(4.26) = 5/2$; $J(5.01) = 1/2$; $J(5.12) = 5/2$; $J(5.53) = 5/2$; $J(5.77) = 7/2$; $J(5.89) = 5/2$; $J(6.16) \leq 5/2$; $J(6.23) \leq 5/2$. (auth)

25526 NUCLEON TRANSFER FORM FACTORS CALCULATED WITH REALISTIC INTERACTIONS. So, Y. K. (Vanderbilt Univ., Nashville); Pinkston, W. T.; Davies, K. T. R. Particles Nucl.; 6: No. 1, 1-31(Jul 1973).

The microscopic approach to calculating single-nucleon transfer form factors is applied to reactions in the region near Ca, e.g., ^{42}Ca(p,d)^{41}Ca and ^{40}Ca(d,p)^{41}Ca. The interaction of the transferred nucleon with the ^{40}Ca core is taken to be the single-particle Hartree–Fock potential of Tarbutton and Davies, based on a two-body potential developed by Nestor. Realistic effective interactions, including core-polarization renormalization, are used for the interaction of the transferred nucleon with valence nucleons and holes. The results are compared to form factors calculated with Woods–Saxon core interactions and phenomenological residual interactions. It is found that the use of the Hartree–Fock potential yields results which are significantly different from those obtained from Woods–Saxon wells of standard geometry (r_0 = 1.25 fm, a = 0.65 fm). Form factors calculated with the Hartree–Fock potential tend to be larger in the surface and smaller in the interior, compared to those calculated with the Woods–Saxon. A Woods–Saxon well equivalent to Hartree–Fock gives almost identical results in some but not all cases, but the parameters of this well are quite different from the standard geometry and are highly state dependent. The form factors are found to be much less sensitive to the effective two-body interaction of the transferred nucleon with the valence particles and holes. (auth)

25527 SELECTIVE POPULATION OF THE LOWEST-LYING NEGATIVE PARITY STATES IN ^{23}Na IN THE ^{12}C(^{12}C,p)^{23}Na REACTION. Voit, H.; Dueck, P.; Galster, W.; Haindl, E.; Ischenko, G.; Siller, F. (Erlangen–Nuernberg Univ., Erlangen, Ger.). Z. Phys.; 266: No. 1, 37-39(1974).

The ^{12}C(^{12}C,p)^{23}Na reaction was investigated in the vicinity of the Coulomb barrier. The lowest-lying negative-parity states in ^{23}Na were found to be preferentially populated at energies for which correlated resonances exist in the excitation functions of the α, p, n and γ exit channels of the ^{12}C + ^{12}C reaction. If these negative-parity states are assumed to consist of a $p_{1/2}$ hole coupled to a ^{20}Ne quartet state, this selectivity can be explained with the existence of α-particle doorway states. (4 figures) (auth)

25528 NEW ASPECTS OF THE ROTATIONAL MODEL IN ^{25}Mg. Roepke, H.; Hammel, G.; Brendler, W.; Betz, P.; Glattes, V. (Univ., Freiburg i. B.). Z. Phys.; 266: No. 1, 55-64(1974).

Spin assignments have been made to the ^{25}Mg levels in the E_x = 5–6 MeV region from γ-ray angular distributions measured in the ^{22}Ne(α,nγ) reaction at E_α = 8.0 and 8.8 MeV and from p–γ angular correlations measured in the ^{24}Mg(d,pγ) reaction at E_d = 6 MeV. Unique spin assignments of $J = 7/2$, $5/2$, $5/2$, and $9/2$ could be made to the levels at E_x = 5005, 5511, 5851, and 5967 keV, respectively. Lifetime estimates have been obtained, using the Doppler-shift attenuation method, for the levels at E_x = 5245 keV (τ = 30–60 fs), 5785 keV (τ = 50–100 fs), 5967 keV (τ = 50–100 fs), and 5455 kev (τ > 1 ps). All other levels in the E_x = 5–6 MeV region have τ < 60 fs. A breakdown of the K-selection rule has been observed in the γ-decay of some high spin states, indicating a deviation from the strong coupling model. (5 figures, 3 tables) (GE)

25529 CONTINUUM CALCULATION FOR THE GIANT DIPOLE RESONANCE IN ^{28}Si INCLUDING THE EFFECT OF COLLECTIVE CORRELATIONS. Mshelia, E. D. (Univ., Frankfurt am Main); Barrett, R. F.; Delsanto, P. P. Z. Phys.; 266: No. 1, 7-11(1974).

Continuum shell model calculations for the giant dipole resonance in ^{28}Si based on both the 1p–1h model and the collective correlation model are described; and the results, compared with experiment. The eigenchannel theory of nuclear reactions has been used to include the effect of the particle continuum. (4 figures, 1 table) (auth)

25530 TAMM-DANCOFF CALCULATION OF EXCITED STATES OF ^{20}Ne. de Oliveira, D. R.; Mizrahi, S. S. (Instituto de Fisica Teorica, Sao Paulo, Brazil). Rev. Brasil. Fis.; 2: No. 3, 311-317(Dec 1972).

The Tamm–Dancoff approximation and the Peierls–Yoccoz projection method are used to obtain the states of the first excited 0^+ band of ^{20}Ne. The energy spectrum and the B(E2) interband and intraband reduced transition probabilities are computed using different types of two-body interactions. The results are not as good as the ones obtained previously for the ground state band. Only one B(E2) experimental measurement is available to compare with. (auth)

25531 INVESTIGATION OF ^{38}Ar LEVELS BY ^{38}Cl + p REACTIONS. II. Lifetimes, Spins, Parities, and Theory. Alderliesten, C.; Van Loon, C. A. L. (Rijksuniversiteit, Utrecht). Nucl. Phys.; A220: No. 2, 317-334(1974).

The mean lives of 16 bound states of ^{38}Ar were determined from DSA measurements at 14 selected ^{37}Cl(p,γ)^{38}Ar resonances in the range E_p = 0.9 to 1.5 MeV. Spins and parities of 20 (p,γ) resonances were determined from a precision comparison with corresponding ^{37}Cl(p,α_0)^{34}S resonances. Gamma-ray transition strengths combined with γ-ray angular distribution measurements at two resonances determine (or limit) the spins of 15 bound states of ^{38}Ar. The experimental data on ^{38}Ar are compared with the results from shell-model calculations. The negative-parity states, especially those with high spin, can be very well described in terms of a model with five active nucleons in the $1d_{3/2}$ shell and one in either the $1f_{7/2}$ or $2p_{3/2}$ shell. For the positive-parity states, the new data underline the importance of two-particle four-hole excitations. (auth)

25532 INVESTIGATION OF ^{38}Ar LEVELS BY ^{37}Cl + p REACTIONS. I. Yield Curves, Excitation Energies and Branching Ratios. Alderliesten, C.; Aerts, P. G. A. M.; Van Bijlert, H. M. J.; Van Der Leun, C. (Rijksuniversiteit, Utrecht). Nucl. Phys.; A220: No. 2, 284-316(1974).

Yield measurements were performed on the reactions ^{37}Cl(p,p_0)-^{37}Cl, ^{37}Cl(p,α_0)^{34}S (E_p = 1.17 to 1.70 MeV) and ^{37}Cl(p,n_0)^{37}Ar, ^{37}Cl-(p,γ)^{38}Ar (E_p = 0.64 to 2.92 MeV); detailed investigations are restricted to resonances below E_p = 1.79 MeV. Resonance energies, strengths and (some) widths are reported for 12, 26 and 247 resonances in the reactions (p,p_0), (p,n_0) and (p,γ), respectively. Simultaneous (p,α_0) and (p,γ) yield measurements over selected E_p intervals in the E_p = 0.88 to 1.64 MeV range established the existence of 42 resonances decaying by both γ and α_0 emission. Analysis of the γ-ray spectra of 100 ^{37}Cl(p,γ)^{38}Ar resonances leads to precision excitation energies (ΔE_x = 0.1 to 2 keV) of 57 bound states (E_x < 8 MeV) and branching ratios of the resonances and of 50 bound states. (auth)

25533 STATISTICAL ANALYSIS OF EXCITATION FUNCTIONS FOR ELASTIC AND INELASTIC SCATTERING OF α-PARTICLES ON Mg AND Si NUCLEI. Bobrowska, A.; Budzanowski, A.; Grotowski, K.; Jarczyk, L.; Kamys, B.; Kapuscik, A.; Ploskonka, J.; Strzalkowski, A.; Wrobel, Z.; Zastawniak, L.; Zybert, R. (Jagiellonian Univ., Krakow). Acta Phys. Pol.; B5: No. 1, 125-133(1974).

The excitation functions for inelastic α-scattering leading to the low lying excited states in ^{24}Mg and ^{28}Si were measured at Θ_{LAB} = 170°, 175° and 179° in the LAB energy range 22.75 to 28.40 MeV. Statistical analysis of these excitation functions and those previously measured for elastic scattering was performed. The direct interaction contribution y_D to the reaction studied was obtained from probability distributions of cross sections and from correlation coefficients. Cross correlation coefficients between different reaction channels were calculated. (auth)

25534 REACTIONS PRODUCED BY PROTONS HAVING ENERGIES OF 1.9 AND 3.1 MeV ON ^{27}Al NUCLEI. Dalmas, J. (Univ., Bordeaux). Compt. Rend., Ser. A, B; 277: No. 10, 237-240(10 Sep 1973). (In French).

A 60 cm^3 Ge(Li) detector was used to study the yield curves of 1779-, 843-, 1013-, 2212-, and 1369-keV γ radiation resulting from ^{27}Al + p reactions for proton energies E^p ranging from 1.9 to 3.1 MeV. The intensities of the resonances were subsequently deduced. (auth)

25535 ELECTRIC CHARGE RADIUS OF ^{36}A. Daniel, H. (Technische Univ., Munich); Pfeiffer, H. J.; Springer, K.; Stoeckel, P.; Backenstoss, G.; Tauscher, L. Phys. Lett.; 48B: No. 2, 109-110(21 Jan 1974).

The electrical charge radius of ^{36}A was measured with muonic X-rays using a gas target filled with 810 atm of hydrogen and an admixture of 3×10^{-5} ^{36}A. For a Fermi type charge distribution, with the surface parameter fixed at t = 2.21 fm, the r.m.s. radius was found to be 3.396 ± 0.007 fm. (auth)

25536 RADIOCHEMICAL INVESTIGATIONS. VI. pp 167-212 of Yadernye Reaktsii Pri Vysokikh Energiyakh. Denisov, F. B.; Makhedov, V. N. (eds.). Moscow; Atomizdat (1972). (In Russian).

This review covers studies of nuclear reactions by the radiochemical method. The results of studies of reactions of the types (p,2p), (p,pn), (p,2n), and (p,n) are considered in a wide range of target elements from C to U. The reaction cross sections are given as a function of proton energy (E_p = 100 MeV to 60 GeV). Spallation reactions of light (Al, C), intermediate, and heavy nuclei (from V to U) are considered at E_p from 100 MeV to tens of a GeV. Great attention is devoted to studying the formation of radioactive fragments of light nuclei which are formed on irradiating heavier nuclei with high-energy particles. Data are presented on the formation cross sections of ^{3}H, ^{6}He, ^{7}Be, ^{9}Li, ^{14}C, ^{17}N and ^{18}F from bombarding various targets with protons having E_p of 100 MeV to 30 GeV. The formation cross section of ^{3}H was also investigated in irradiating targets with deuterons (E_d of 70 to 390 MeV) and with alpha particles (E_α of 140 to 750 MeV). The radiochemical method is the only method of studying secondary reactions, that is, the interaction of fragments with target nuclei. Results are presented of studies of the cross section of the secondary reactions [p (α,xn)], [p (Li, xn) and [p (Be, xn)] as a function of the energy of bombarding protons. For the [p (Li, xn)] reaction on a Pb target the cross section is also given as a function of the type of bombarding particles, that is, proton, alpha, or deuteron. A large part of the studies on recoil nuclei were carried out with ^{24}Na nuclei from the reaction ^{27}Al(p,3pn)^{24}Na. The angular distribution and range of ^{24}Na nuclei were obtained. (tr-auth).

25537 RECENT EXPERIMENTS ON ELASTIC ELECTRON SCATTERING AT THE MAINZ 300 MeV LINAC. Ehrenberg, H. (Univ., Mainz). Kakuriken Kenkyu Hokoku; 5: 85-101(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendei, Japan (12 Sep 1972). See CONF-720907-.

Some experimental and technical improvements made during the preceding two years to increase precision are described, and some typical data are shown. New results for root-mean-square nuclear radii in terms of phenomenological charge distributions are presented for ^{31}P, ^{32}S, ^{40}Ar, ^{90}Zr, and isotopes of Fe, Ni, Cu, Zn, and Mo. Finally, a model-independent method for evaluation and interpretation of elastic scattering results is discussed. (6 figures, 5 tables) (RWR)

25538 DETERMINATION OF DEFORMATIONS OF ^{20}Ne AND ^{28}Si. Horikawa, Y. (Juntendo Univ., Narashino, Japan); Nakada, A.; Torizuka, Y. Kakuriken Kenkyu Hokoku; 5: 29-37(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendei, Japan (12 Sep 1972). See CONF-720907-.

An analysis of elastic and inelastic electron scattering from the members of the ground-state bands of ^{20}Ne and ^{28}Si is discussed. A phenomenological, deformed Fermi-like density is assumed for the intrinsic charge distribution. Best-fit form factors are shown for the ground, 2^+, and 4^+ states, along with the parameters which produce these curves. Inelastic form factors calculated with the projected model are compared with those found by using the rotational model. (8 figures, 1 table) (RWR)

25539 DEFORMATIONS OF NUCLEI DETERMINED FROM ELECTRON SCATTERING. Ripka, G. (CEN de Saclay, Gif-sur-Yvette, France). Kakuriken Kenkyu Hokoku; 5: 7-27(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendei, Japan (12 Sep 1972). See CONF-720907-.

The structure of light nuclei is discussed in terms of microscopic wave functions obtained either by Hartree–Fock theory or by the diagonalization of 2s1d-shell configurations. The possible confusion due to limited configuration space is pointed out. Elastic form factors calculated by the two above methods are shown for ^{20}Ne, ^{24}Mg, and ^{28}Si; these are followed by form factors for the $0^+ \rightarrow 2^+$ transition to the first excited 2^+ state for the same six cases. Next, the form factors for the $0^+ \rightarrow 4^+$ transitions in ^{20}Ne and ^{28}Si obtained from the deformed Hartree–Fock wave functions are presented. It was found that the first peak in the elastic form factor is systematically obtained too low and that some readjustment of the inner closed shells may be responsible for the discrepancy; that an effective charge $e_p = 1.5e$ and $e_n = 0.5e$ is adequate for the first peak of quadrupole transitions in Ne, Mg, and Si and that a slightly larger effective charge may be needed for hexadecupole transitions; that the Hartree–Fock solutions with orbits expanded up to the N = 4 shell are in no need of an effective charge; and that hexadecupole transitions rule out the ^{28}Si polate shape. Preliminary eikonal estimates of electron scattering on heavy deformed nuclei are discussed in the final section. These are compared with Born-approximation results for elastic scattering and the $0^+ \rightarrow 4^+$ transition in ^{160}Gd. (18 figures, 2 tables) (RWR)

25540 COMPOUND NUCLEAR LIFETIME EFFECT ON THE MINIMUM YIELD OF BLOCKING PHENOMENA. Fujimoto, F. (Univ., Munich); Komaki, K.; Nakayama, H.; Ishii, M.; Hisatake, K. Radiat. Eff.; 20: No. 1-2, 141-144(1973).

Previous work (Komaki et al., Phys. Lett.; 38B: 218(1972)) reported on lifetime measurements for the ^{27}Al(p,α)^{24}Mg reaction. The α-particles were detected by celluloid films. The reaction times were determined from the ratio of the dip areas in the (111) and (11$\bar{1}$) planar blocking direction. In the present work, a study is reported of the effect of the reaction time on the minimum yield in the axial and planar blocking dips. (UK)

25541 FINAL STATE SPIN DEPENDENCE AND MECHANISM OF THE ^{27}Al(d,α)^{25}Mg AND ^{25}Mg(d,α)^{23}Na REACTIONS. Takeuchi, Y.; Griffith, J. A. R.; Karban, O.; Roman, S. (Univ. of Birmingham, Eng.). Nucl. Phys., A220: No. 3, 589-603(1974).

Differential cross section excitation functions and vector analyzing powers of the ^{27}Al(d,α)^{25}Mg reaction and the vector analyzing power of the ^{25}Mg(d,α)^{23}Na reaction were measured for incident deuteron energies up to 12.3 MeV. An attempt was made to describe the results obtained with the statistical model using the autocorrelation function method. A distinct dependence of the cross section and vector analyzing power results upon the spin of the final state was observed. (auth)

25542 PROJECTILE COULOMB EXCITATION OF ^{20}Ne AND ^{22}Ne. Olsen, D. K.; Barnett, A. R.; Biagi, S. F.; Merrill, N. H.; Phillips, W. R. (Univ. of Manchester, Eng.). Nucl. Phys.; A220: No. 3, 541-568(1974).

The static quadrupole moments of the first excited $J^\pi = 2^+$ states in ^{20}Ne and ^{22}Ne and the reduced electric quadrupole transition probabilities of these states to the ground states were measured via projectile Coulomb excitation. The quadrupole moments were deduced from the shapes of γ-ray angular distributions. The results are: $Q(^{20}\text{Ne},2^+) = -0.20 \pm 0.05$ b and $Q(^{22}\text{Ne},2^+) = -0.11 \pm 0.05$ b. The transition strengths were deduced from yield measurements and by comparison with the yields of target γ-rays. The results are: $B(E2;\, 0^+ \rightarrow 2^+,\, ^{20}\text{Ne}) = 0.037 \pm 0.003\ e^2 \cdot b^2$ and $B(E2;\, 0^+ \rightarrow 2^+,\, ^{22}\text{Ne}) = 0.025 \pm 0.002\ e^2 \cdot b^2$. The results for the transition strengths are consistent with the results of accurate timing methods and resolve discrepancies between previous experiments. The results for the quadrupole moments are consistent with earlier measurements, although the mean values obtained are slightly lower. The experimental measurements are compared with theoretical predictions, and a detailed discussion is given of corrections to this type of reorientation experiment. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 23916, 25236, 25488, 25493, 25516, 25523, 25536, 25537, 25639, and 25676.

25543 (ANU-P-581) ^{56}Fe(α,γ)^{60}Ni REACTION AT EXCITATION ENERGIES IN THE REGION OF THE GIANT DIPOLE RESONANCE. Foote, G. S.; Branford, D.; Bell, R. A. I.; Watson, R. B. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Dec 1973. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

Excitation functions for the ^{56}Fe(α,γ_0)^{60}Ni and ^{56}Fe(α,γ_1)^{60}Ni reactions were measured at 90° to the beam direction over the bombarding energy range 8.0 to 17.6 MeV. Gamma-ray angular distributions were measured at ten bombarding energies. Excitation functions for the ^{59}Co(p,γ_0)^{60}Ni and ^{59}Co(p,γ_1)^{60}Ni reactions were measured over the range E_x = 16.58 to 16.92 MeV and compared with the (α,γ) data. The angular distribution data indicate that the (α,γ_0) and (α,γ_1) reactions proceed through 1^-, and 1^- and 3^- states, respectively. The (α,γ) excitation functions are discussed with respect to isospin splitting of the ^{60}Ni giant dipole resonance. The fine structure observed in the excitation functions is shown to be most probably due to Ericson fluctuations. The gross (α,γ) cross sections are shown to be in reasonable agreement with the results of calculations made using the theory of Hauser and Feshbach assuming excitation of the giant dipole resonance. (11 figures) (auth)

25544 (COO-3001-53) SELF-SCREENING OF THE PARTICLE-HOLE INTERACTION AND CORE POLARIZATION OF THE EFFECTIVE TWO-PARTICLE INTERACTION. Kuo, T. T. S.; Osnes, E. (State Univ. of New York, Stony Brook (USA). Dept. of Physics; Oslo Univ. (Norway). Fysisk Institutt). 1973. Contract AT(11-1)-3001. 34p. Dep. NTIS $3.75.

The diagrams of the Tamm–Dancoff and random-phase approximations (TDA and RPA) were summed to calculate the core polarization of the effective interaction between two nucleons in the (1s0d) and (1p0f) shells. The large core-polarization corrections obtained in the TDA and particularly the RPA are strongly reduced when the self-screening corrections to the particle-hole and ground-state correlation vertices are included. The screening corrections serve to suppress the collectivity of the core phonons and in particular stabilize the isoscalar monopole phonon in ^{40}Ca against collapse. When screening is included the TDA and RPA give core-polarization corrections which are similar in magnitude and in many cases lead to good agreement with experiment. Because of neglected effects and other uncertainties the qualitative rather than the quantitative features of the results are stressed. (auth)

25545 (COO-3058-39, pp 22-31) DIFFERENTIAL ELASTIC SCATTERING CROSS SECTIONS OF keV NEUTRONS FROM IRON AND NICKEL. Zuhr, R.; Min, K. [nd].

In linear accelerator project. Annual technical report, October 1, 1972–September 30, 1973.

25546 (COO-3464-13) NUCLEAR STRUCTURE STUDIES. Technical Progress Report, 1 January 1973–31 December 1973. Preiss, I. L. (Rensselaer Polytechnic Inst., Troy, N.Y. (USA)). Jan 1974. Contract AT(11-1)-3464. 47p. Dep. NTIS $4.50.

Studies were done in the following areas: decay mode and level structure of the A = 56 isobar; effects of band mixing and deformation on the formation and decay of ^{129}Ba isomers; heavy-ion reactions in the A = 100 region; computation of angle, energy, and momentum distributions of outgoing products in transfer reactions; and photonuclear processes. Three of the papers are separately title listed. (RWR)

For title listing of individual papers see: 25547, 25548, and 25565.

25547 (COO-3464-13, pp 9-10; 11-13) PHOTONUCLEAR REACTIONS. Jan 1974.

In nuclear structure studies.

25548 (COO-3464-13, pp 42-43) LIFETIME MEASUREMENTS OF THE EXCITED STATES OF ^{56}Co. Jan 1974.

In nuclear structure studies.

25549 (JINR-P4-7534) INFLUENCE OF THE ISOTOPE-INVARIANT PAIR CORRELATIONS ON THE ROOT-MEAN-SQUARE RADII. Afanas'ev, G. N.; Dzholos, R. V.; Kartavenko, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The influence of the isotope-invariant pair correlations on the mean-square radii of nuclei (RMS) is studied. RMS are calculated for the Cr, Fe, Ni and Zn. It is shown that taking into account of the pairing leads to increase of RMS by 1 to 2%, as compared with the value obtained with the help of the shell model, and gives a qualitatively right behavior of the RMS along the isotopes. In a quantitative relation the pair correlations at various values of the pairing constants couldn't explain the anomalies observed. (auth)

25550 (JINR-P4-7589) STUDY OF NUCLEAR INTERACTION PARAMETERS OF NEAR-THE-BARRIER NI EXCITATION BY LIGHT NUCLEI. Titov, A. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Near-the-barrier excitation of the one-phonon 2^+ level in ^{58}Ni in the reactions with ^{3}He, ^{6}Li, ^{16}O is studied. It is found out that the nuclear interaction parameters for the reactions with He and Li differ rather essentially from the parameters of the oxygen interaction. This fact leads to the smoothing of the interference effect in the reactions with ^{3}He and ^{6}Li. (auth)

25551 (ORNL-4907) ^{54}Fe NEUTRON ELASTIC AND INELASTIC SCATTERING CROSS SECTIONS FROM 5.50 TO 8.50 MeV. Kinney, W. E.; Perey, F. G. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. 35p. Dep. NTIS $4.00.

Measured ^{54}Fe neutron elastic scattering cross sections and cross sections for inelastic scattering to 7 discrete levels or groups of levels in ^{54}Fe in the incident neutron energy range from 5.50 to 8.50 MeV are presented. The elastic data are in good agreement with natural iron results. Inelastic scattering to the 1.409 MeV level shows evidence of direct reaction contributions at the higher incident neutron energies. ENDF/B III MAT 1180 natural iron cross sections for inelastic scattering to the 1.409 MeV level in ^{54}Fe are higher by a factor of 2 than these data. Cross sections for inelastic scattering to levels in the residual nucleus of excitation energy greater than 4.29 MeV are presented as continuum cross sections. It is found that an evaporation model of continuum inelastic scattering is adequate above 6.2 MeV excitation energy but is questionable in describing inelastic scattering to lower-lying levels. (auth)

25552 (τ,p) REACTION ON ^{42}Ca AND ^{50}Cr AT 35 MeV. Guichard, A. (Univ., Lyon); Gaillard, P.; Grossiord, J. Y.; Fortier, S. (Univ., Lyon). J. Phys. (Paris); 34: No. 10, 771-782(Oct 1973). (In French).

The reactions ^{42}Ca(τ,p)^{44}Sc and ^{50}Cr(τ,p)^{52}Mn were studied at 35 MeV. Glendenning's theory was used for the analysis of the experimental results. The lower lying levels of the residual nuclei corresponding to f($^7/_2$) configuration are weakly or very weakly excited. Results concerning ^{44}Sc were analyzed using the shell-model wave functions within the 1 f($^7/_2$)–2 p($^3/_2$) configuration space, such a basis being insufficient to account for the cross sections of the analog states. In the spectrum of ^{52}Mn, a great number of 1^+ states were observed. (FR)

25553 NEUTRON-INDUCED GAMMA-RAY PRODUCTION IN CALCIUM IN THE ENERGY RANGE $0.7 \leq E_n \leq 20$ MeV. Dickens, J. K.; Love, T. A.; Morgan, G. L. (Oak Ridge National Lab., TN). Nucl. Sci. Eng.; 53: No. 3, 277-284(Mar 1974).

Gamma-ray spectra were obtained at θ_γ = 125 deg for reactions involving neutron interactions with a sample of natural calcium. Cross sections for the production of gamma rays were deduced from these spectra as a function of both neutron and photon energy. The data were obtained by using a NaI spectrometer system and the Oak Ridge Electron Linear Accelerator as the neutron source. The experimental results are compared with predictions based on the gamma-ray files of the current Defense Nuclear Agency evaluation for calcium (Mat 4152 Mod 3) and with previous experimental data. Although there is generally good (15%) agreement, important differences are discussed. (6 figures) (auth)

25554 CALIBRATION OF THE ISOMER SHIFT OF ^{57}Fe. Rueegsegger, P.; Kuendig, W. (Univ., Zurich). Helv. Phys. Acta; 46: No. 2, 165-179(15 Aug 1973).

The influence of the chemical environment on the lifetime of the 14.4-keV state in ^{57}Fe was measured. The result, together with Moessbauer measurements, determined the change in the charge radius between the excited and the ground state as $\Delta R/R = -(3.1 \pm 0.5) \times 10^{-4}$. (10 figures, 3 tables) (auth)

25555 ABSOLUTE (n,p) AND (n,α) CROSS SECTIONS FOR ^{39}K AND ^{40}Ca BETWEEN 2.4 AND 2.9 MeV. Bartle, C. M.; Johnson, P. B.; Chapman, N. G. (Univ. of Wellington, New Zealand). Nucl. Phys.; A220: No. 2, 395-403(1974).

Absolute (n,p) and (n,α) cross sections for ^{39}K and ^{40}Ca were measured between 2.4 and 2.9 MeV. The associated particle technique is employed to measure the neutron flux. A careful error evaluation based on the experimentally determined neutron beam profile was made. The (n,p) and (n,α) cross sections have typical uncertainties of 6 and 10%, respectively. Although excellent systematic agreement with earlier data is found in the case of the (n,α) results, the agreement is poorer for the (n,p) cross sections. The variation of the ^{40}Ca(n,p) cross section with energy is found to be correlated with the variation in total neutron cross section. (auth)

25556 EVIDENCE FOR THE DEUTERON–NUCLEUS TENSOR INTERACTION. Roche, R.; Nguyen Van Sen; Perrin, G.; Gondrand, J. C.; Fiore, A.; Mueller, H. (Institut des Sciences Nucleaires, Grenoble, France). Nucl. Phys.; A220: No. 2, 381-390(1974).

Measurements for the elastic scattering of polarized deuterons from ^{40}Ca and ^{56}Fe at 30 MeV and from ^{90}Zr and ^{208}Pb at 28.8 MeV are presented. Angular distributions of the cross section, of the vector analyzing power iT_{11} and of the quantity $T_{22}-\sqrt{\tfrac{2}{3}}\,T_{20}$ were deduced. Analyses of the data in terms of the optical model present evidence for the deuteron-nucleus tensor interaction. (auth)

25557 CHARGE COLLECTION METHOD OF TOTAL REACTION CROSS-SECTION MEASUREMENTS FOR ALPHA PARTICLES. Karcz, W.; Szmider, J.; Szymakowski, J.; Wolski, R. (Inst. of Nuclear Physics, Krakow). Acta Phys. Pol.; B5: No. 1, 115-124(1974).

The electric charge collection method was developed for measurements of the total reaction cross section for the interaction of alpha particles with nuclei. The effect of electron capture by alphas in the target material was reduced by carbon foil placed behind the target. The results for natural targets of Ni, Co, Cu, Pd, Ag, In, Sn, Ta, Pt, Au, Pb, and Bi at alpha particle energies 23.2 MeV and 27.8 MeV are presented. (auth)

25558 ALPHA CAPTURE TO THE ^{40}Ca GIANT QUADRUPOLE RESONANCE. Branford, D. (Australian National Univ., Canberra). Particles Nucl.; 6: No. 4, 127-132(Oct 1973).

It is shown that the $^{36}Ar(\alpha,\gamma_0)^{40}Ca$ reaction most probably excites a giant quadrupole resonance in addition to the giant dipole resonance. Properties of the giant quadrupole resonance and its effects on (p,γ) capture reactions are discussed. (auth)

25559 TEST OF THE RELIABILITY OF THE DOPPLER SHIFT ATTENUATION TECHNIQUE FOR THE MEASUREMENT OF LIFETIMES IN MEDIUM-WEIGHT NUCLEI. Fisher, T. R. (Lockheed Palo Alto Research Lab., CA); Bond, P. D. Particles Nucl.; 6: No. 4, 119-126(Oct 1973).

Lifetimes measured by the Doppler shift attenuation technique are compared with the results of other types of lifetime measurements for several nuclei ranging from ^{44}Ca to ^{136}Ba. The use of the energy loss theory of Lindhard, Scharff and Schiott together with the Blaugrund theory of nuclear collisions leads to lifetimes which are in good agreement with Coulomb excitation and resonance fluorescence results. No evidence is found for discrepancies which depend in a systematic way on atomic number. (auth)

25560 INVESTIGATION OF ISOTOPIC EFFECTS IN NUCLEAR REACTIONS INDUCED BY 660-MeV PROTONS. Bogatin, V. I.; Bondarev, V. K.; Litvin, V. F.; Lozhkin, O. V.; Perfilov, N. A.; Yakovlev, Yu. P.; Bochin, V. P. Yadern. Fiz.; 19: No. 1, 32-44 (Jan 1974). (In Russian).

Cross sections for production of hydrogen, helium and lithium isotopes at inelastic collisions of 660-MeV protons with nuclei ^{58}Ni, ^{64}Ni, ^{112}Sn, ^{124}Sn are measured in the experiment. Ratios of the production cross sections for the isotopes ^{2}H, ^{3}H, ^{4}He, ^{3}He, ^{6}He, ^{6}Li, ^{7}Li, ^{8}Li, ^{7}Be and the differential energy spectra of ^{3}He and ^{4}He are obtained for the mentioned isotope pairs of the target nuclei. Two isotopic effects are detected: a correlation between the absolute production cross sections for the product isotope particles and the mass number of the target nuclear isotopes, and a variation of shape of the particle energy spectra at substituting one target isotope by another. Dependence of the ratio of the production cross sections on the product particle isospin and on the difference between their separation energies for two target isotopes is found. (auth)

25561 LONGITUDINAL POLARIZATION OF THE EMITTED NEUTRON IN DIRECT MUON CAPTURE. Bouyssy, A.; Vinh Mau, N. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett.; 48B: No. 2, 162-164(21 Jan 1974).

The neutron longitudinal polarization was calculated for ^{40}Ca using different wave functions for the bound proton and the emitted neutron. It is shown to be more sensitive to the final state interaction than to the details of the nuclear density. (auth)

25562 EVEN-PARITY SPECTRUM OF ^{44}Ca. Skouras, L. D. (Democritos Nuclear Research Center, Aghia Paraskevi Attikis, Greece). Nucl. Phys.; A220: No. 3, 604-620(1974).

An extended model allowing for the mixing between 4p spherical and 6p-2h deformed configurations is introduced for the interpretation of the even parity spectrum of ^{44}Ca. Six intrinsic 6p-2h configurations are considered in the calculation. The theoretical results are found to be in good agreement with experimental results, both on energy levels and transition rates. (auth)

25563 $^{56}Fe(\alpha,\gamma)^{60}Ni$ REACTION AT EXCITATION ENERGIES IN THE REGION OF THE GIANT DIPOLE RESONANCE. Foote, G. S.; Branford, D.; Bell, R. A. I.; Watson, R. B. (Australian National Univ., Canberra). Nucl. Phys.; A220: No. 3, 505-519 (1974).

Excitation functions for the $^{56}Fe(\alpha,\gamma_0)^{60}Ni$ and $^{56}Fe(\alpha,\gamma_1)^{60}Ni$ reactions were measured at 90° to the beam direction over the bombarding energy range 8.0 to 17.6 MeV. Gamma-ray angular distributions were measured at ten bombarding energies. Excitation functions for the $^{59}Co(p,\gamma_0)^{60}Ni$ and $^{59}Co(p,\gamma_1)^{60}Ni$ reactions were measured over the range $E_x = 16.58$ to 16.92 MeV and compared with the (α,γ) data. The angular distribution data indicate that the (α,γ_0) and (α,γ_1) reactions proceed through 1^-, and 1^- and 3^- states, respectively. The (α,γ) excitation functions are discussed with respect to isospin splitting of the ^{60}Ni giant dipole resonance. The fine structure observed in the excitation functions is shown to be most probably due to Ericson fluctuations. The gross (α,γ) cross sections are shown to be in reasonable agreement with the results of calculations made using the theory of Hauser and Feshbach assuming excitation of the giant dipole resonance. (auth)

25564 ^{6}Li-INDUCED THREE-NUCLEON TRANSFER REACTION ON ^{40}Ca. Lindgren, R. A.; Markham, R. G.; Fulbright, H. W. (Univ. of Rochester, NY). Phys. Lett.; 48B: No. 3, 209-211(4 Feb 1974).

Analog $(fp)^3$ states preferentially excited in the $^{40}Ca(^{6}Li,t)^{43}Ti$ and the $^{40}Ca(^{6}Li,^{3}He)^{43}Sc$ reactions were identified in the mass-43 mirror nuclei. A simple zero-range DWBA calculation made with a cluster form factor gives good agreement with the measured angular distributions, but spectroscopic strengths deduced for mirror levels do not agree. The 3p−0h states are excited with a rather uniform cross section not strongly correlated with spins. (auth)

Nuclear Properties and Reactions, $59 \leq A \leq 89$

Refer also to abstracts 23916, 25523, 25537, 25543, 25545, 25549, 25559, and 25590.

25565 (COO-3464-13, pp 10; 14-24) ISOMERISM IN ^{76}Se. Jan 1974.

In nuclear structure studies.

25566 (IS-T-627) DELAYED NEUTRON EMISSION FROM MASS-SEPARATED FISSION PRODUCTS. Norman, J. H. (Ames Lab., Iowa (USA)). Feb 1974. Contract W-7405-eng-82. 132p. Dep. NTIS $8.75.

Thesis.

Delayed neutron characteristics of six fission product nuclides were determined using a mass separator operated on-line with a nuclear reactor. Beta-decay half-lives were measured using neutron multiscaling techniques for the precursors ^{88}Br, ^{89}Br, ^{92}Kr, ^{93}Kr, ^{137}I, and ^{138}I. The observed half-lives were 16.52 ± .34, 4.32 ± .05, 1.296 ± .022, 5.926 ± .044, 24.42 ± .08, and 6.40 ± .17 seconds, respectively. Energy spectra were measured for delayed neutrons emitted in the beta-decays of ^{17}N, ^{137}I, ^{93}Kr, and ^{93}Rb. The spectra of neutron emissions in the mass 93 parent-daughter decay chain were observed using a moving tape collector to effect isobaric separation. Two different types of ^{3}He-filled neutron spectrometer were used to determine the spectra; a proportional counter with risetime discrimination electronics, and a high resolution ionization chamber. The measured delayed neutron spectra using both detector types are presented, and the results compared, where possible, with other reported measurements. (auth)

25567 (LIB/Trans-512) IONISATION EFFECTS DURING K-SHELL CAPTURE IN Zn^{65}. Kaipov, D. K.; Lysikov, Yu. A.; Shubnyi, Yu. K. Translated from Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; 8: No. 6, 11-14(1970). 7p. Dep. NTIS (U. S. Sales Only) $3.00.

Ionization effects in molecular systems during K capture and subsequent Auger transitions were investigated by means of nuclear resonance scattering of γ radiation with energy of 1.118 MeV by ^{65}Cu nuclei. The cross section of resonance scattering was measured for three ^{65}Zn compounds: $ZnCl_2$, $ZnBr_2$, and ZnI_2. Energy compensation, lost or recoil, is achieved on account of (at the expense of) Coulomb fragmentation of charged molecular ions, arising during Auger transitions, following K capture in ^{65}Zn. The relation between the cross section of resonance scattering and atomic number of the halogen in the compound is under study. (tr-auth)

25568 (ORNL-4908) ^{63}Cu AND ^{65}Cu NEUTRON ELASTIC AND INELASTIC SCATTERING CROSS SECTIONS FROM 5.50 TO 8.50 MeV. Kinney, W. E.; Perey, F. G. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. Contract W-7405-eng-26. 35p. Dep. NTIS $4.00.

Measured neutron elastic and inelastic scattering cross sections for ^{63}Cu and ^{65}Cu between 5.50 and 8.50 MeV are presented and compared with elastic data of Holmqvist and Wiedling and with ENDF/B III MAT 1085 and 1086. The elastic differential cross sections are in fair agreement with those of Holmqvist and Wiedling in shape. The angle-integrated differential elastic cross sections are systematically higher by as much as 28% than those of Holmqvist and Wiedling above 5 MeV, a situation similar to that found in comparing the two sets of data for other elements. ENDF/B III MAT 1085 and 1086 angular distributions underestimate the elastic forward peak below 20 deg. when compared with experimental results and display unphysical fluctuations due to the use of a Legendre series of order 20 where order 9 is the highest required by the data. An evaporation model with temperature ranging from 0.8 to 1.05 MeV reasonably describes inelastic scattering to levels in the residual copper nuclei of excitation energy above 3.2 MeV. (auth)

25569 (ORNL-TM-4464) GAMMA-RAY PRODUCTION DUE TO NEUTRON INTERACTIONS WITH ZINC FOR INCIDENT NEUTRON ENERGIES BETWEEN 0.85 AND 20 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Love, T. A.; Morgan, G. L. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. Contract W-7405-eng-26. 55p. Dep. NTIS $4.75.

Numerical values of differential cross sections for gamma rays produced by neutron reactions with tin were obtained for neutron energies between 0.85 and 20 MeV for $\theta_\gamma = 125$ deg. The $d^2\sigma/d\omega dE$ values were obtained by using a NaI spectrometer. These data are presented as gamma-ray production group cross-section values of $d^2\sigma/d\omega dE$ for $0.7 \leq E_\gamma \leq 10.5$ MeV, with gamma-ray intervals ranging from 20 keV for $E_\gamma \leq 1$ MeV to 160 keV for $E_\gamma \sim 9$ MeV. Neutron energy intervals varied from 0.15 MeV for $E_n = 0.85$ to 1 MeV to 3 MeV for $E_n = 14$ to 20 MeV. (22 figures, 25 tables) (auth)

25570 SPINS OF COMPOSITE STATES OF NUCLEI ^{130}Xe AND ^{124}Te. Danilov, M. M.; Ermakov, O. N.; Vasil'ev, V. V.; Karpikhin, I. L.; Risukhin, V. K. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 19: No. 1, 3-4(Jan 1974). (In Russian).

Spin of the composite capture-state nuclei ^{130}Xe and ^{124}Te is determined by measuring the averaged over spectrum circular polarization of γ quanta emitted by the nuclei after the capture of polarized thermal neutrons. For the nuclei ^{130}Xe and ^{124}Te it is found $J_c = 1^+$. (auth)

25571 RADIOCHEMICAL STUDY OF THE EXCITATION FUNCTION OF THE REACTION ^{59}Co(p,pπ^+)^{59}Fe. Nikityuk, L. N.; Pokrovskii, V. N.; Rybakov, V. N. Sov. Radiochem. (Engl. Transl.); 15: No. 1, 104-107(1973).

Translated from Radiokhimiya; 15: No. 1, 106-110(1973).

The excitation function of the reaction ^{59}Co(p,pπ^+)^{59}Fe over the range of proton energies from the threshold to 660 MeV was measured by a radiochemical method. It was shown that in the case of thick targets the contribution from secondary reactions depends on the proton energy. The data agree satisfactorily with the theoretical calculations of Selleri for ^{65}Cu. (4 figures, 2 tables) (auth)

25572 NUCLEAR ELASTIC AND INELASTIC SCATTERING OF IRON CAPTURE GAMMA-RAYS FROM LEAD AND NICKEL. Bianchini, F. G. (Instituto de Energia Atomica, Sao Paulo, Brazil). Rev. Brasil. Fis.; 2: No. 3, 191-199(Dec 1972).

An experimental study of some highly excited individual nuclear levels near the threshold for particle emission was carried out employing capture gamma-rays from iron, through nuclear resonant scattering measurements. The experiments were performed at a direct-beam tube facility of the IEA-R1 reactor. A large volume Ge(Li) detector installed on a rotating table was used to perform the measurements. The energies of the elastically and inelastically scattered gamma-rays, as well as the angular distribution of the elastically scattered gamma-rays from lead and nickel are presented. The spins of the resonant levels were determined and found to be in agreement with previous determinations. (auth)

25573 SINGLE-HOLE-CORE COUPLING IN THE N = 50 REGION. Basu, S. K.; Sen, S. (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Phys.; A220: No. 3, 580-588(1974).

The level schemes and electromagnetic properties of ^{85}Kr, ^{85}Sr, ^{87}Sr and ^{89}Zr are calculated in a semi-microscopic model which couples the neutron hole motion in the N = 28 to 50 shell to the quadrupole and octupole vibrations of the core. The calculations are compared with recent experimental results. (auth)

Nuclear Properties and Reactions, $90 \leq A \leq 149$

Refer also to abstracts 23893, 23916, 25146, 25486, 25488, 25509, 25536, 25537, 25556, 25557, 25559, 25560, and 25566.

25574 (ANU-P-584) PROGRAMS FOR γ-RAY ANGULAR DISTRIBUTIONS FOLLOWING COMPOUND NUCLEAR REACTIONS. Thompson, J. V. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Dec 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

The compound nucleus angular distribution/correlation program MANDY has been used for some years. The input data for MANDY consist mainly of sets of transmission coefficients calculated by the program PEREY3. The preparation of the input for the latter requires much repetitious and tedious card punching. The 1800 program ALVE was written to prepare an input deck for PEREY3 automatically. The use of this series of programs for the analysis of experimental data is described. (RWR)

25575 (CEA-CONF-2460) EXPERIMENTAL STUDY OF THE GIANT RESONANCE OF HEAVY NUCLEI WITH MONOCHROMATIC PHOTONS. Bergere, R.; Beil, H.; Carlos, P.; Lepretre, A.; de Miniac, A.; Veyssiere, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91, Gif-sur-Yvette (France). Dept. de Physique Nucleaire). [nd]. 25p. (CONF-721215-2). Dep. NTIS (U.S. Sales Only) $3.25.

From seminar on electromagnetic interactions of nuclei at small and medium energies; Moscow, USSR (Dec 1972).

A summary of some experimental data recently obtained at Saclay for transitional and spherical heavy nuclei is presented. The main purpose is to try to connect these data with the predictions of the various dynamic collective models in which the dipole oscillation is coupled with the low-energy collective motions of the nucleus. (16 figures, 2 tables) (auth)

25576 (CEA-CONF-2463) ANALOG STATES IN ANALOG REACTIONS. Ashery, D.; Finkel, G.; Yavin, A. I.; Bruge, G.; Chaumeaux, A. (Tel Aviv Univ. (Israel); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). [nd]. 1p. (CONF-730854-1). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on nuclear physics; Moscow, USSR (27 Aug 1973).

The ^{95}Mo(p,d)^{94}Mo, ^{94}Mo(^{3}He,d)^{95}TcA, and ^{94}Mo(^{3}He,dp)^{94}Mo reactions were studied. Combined with previous results from the ^{94}Mo(d,p)^{95}Mo reaction, this work comprises a complete study of the four analog reactions. A typical two-parameter spectrum from the ^{90}Zr(^{3}He,dp)^{90}Zr reaction is shown; for each state in the final nucleus a kinematic line is observed in the spectrum. (2 figures) (RWR)

25577 (COO-3058-39) LINEAR ACCELERATOR PROJECT. Annual Technical Report, October 1, 1972 – September 30, 1973. Gaerttner, E. R. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA)). [nd]. Contract AT(11-1)-3058. 64p. Dep. NTIS $5.25.

Research on neutron cross sections and experimental and theoretical research on reactor physics and engineering are summarized. A list of theses and publications issued during the period is appended. (JFP)

For titles of selected papers see: 25473, 25545, and 25617.

25578 (JINR-P4-7482) VOLUME CONSERVING PAIRING IN THE RARE EARTH REGION NUCLEI. Bal'butsev, E. B.; Bochnacki, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A method is considered proposed previously for calculation of parameters of pairing interaction in nuclei. Proton and neutron gaps in nuclei of the rare earth region are calculated. A good agreement with experiment is obtained. (auth)

25579 (JINR-P4-7533) PROPERTIES OF LOW-LYING COLLECTIVE STATES OF EVEN Mo ISOTOPES. Dzholos, R. V.; Denau, F.; Kartavenko, V. G.; Yanssen, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Based on the collective Hamiltonian, constructed in the framework of the microscopic nucleus model, the properties of low lying collective states of a number of even isotopes Mo were analyzed. It is shown that in spite of the relatively low excitation energy 0_2^+ states in ^{96,98,100}Mo are not deformed ones as it was previously assumed. (auth)

25580 (LYCEN-7331) LIFETIME MEASUREMENTS FOR THE FIRST EXCITED STATES IN ^{107}Cd AND ^{105}Cd. Rougny, R.; Meyer-Levy, M.; Beraud, R.; Rivier, J.; Moret, R. (Lyon-1 Univ., 69–Villeurbanne (France). Inst. de Physique Nucleaire; Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). Jun 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

The first excited levels of ^{107}Cd and ^{105}Cd were studied using delayed coincidence measurements. The following results were obtained: τ(205 keV, ^{107}Cd) = (1.03 ± 0.05)ns, τ(321 keV, ^{107}Cd) ≤ 60 ps, τ(131 keV, ^{105}Cd) = (2.52 ± 0.15)ns. These results are in agreement with the predictions of the intermediate coupling model. (auth)

25581 NUCLEAR CHARGE DISTRIBUTIONS. Barrett, R. C. (Univ. of Surrey, Guildford, Eng.). Rep. Progr. Phys.; 37: No. 1, 1-54(1974).

Different methods of obtaining information about nuclear charge distributions are reviewed and the nature of this information is discussed. The calculations involved in the analysis of electron scattering and electronic and muonic atom measurements are described with particular reference to the approximations made and the small corrections which must be taken into account. A number of calculations based on dynamical models of the nucleus are discussed and examples are given of the resulting densities. Results are given for selected nuclei and for certain groups of isotopes and isotones, and comparisons are made between phenomenological and theoretically derived densities. (auth)

25582 LINEAR POLARIZATION MEASUREMENT OF THE 245-keV γ RADIATION OF ^{111}Cd. Kreische, W.; Lampert, W. (Univ., Erlangen, Ger.). Z. Phys.; 266: No. 1, 51-53(1974). (In German).

A Compton polarimeter for linear polarization measurements of γ-quanta, consisting of two thin NaI crystals, is described. The linear polarization correlation of the 171–245 keV cascade in ^{111}Cd was measured. The E2 character of the 245 keV quanta follows immediately from this correlation measurement. The mixing ratio δ of the 171 keV quanta was confirmed to be δ_1 = +0.145. The polarization sensitivity of the polarimeter is discussed. (3 figures) (auth)

25583 INVESTIGATION OF NUCLEAR REACTIONS AT LOW AND MEDIUM ENERGY. Nemilov, Yu. A. (Inst. of Radium, Leningrad). Isotopenpraxis; 9: No. 11/12, 406-408(1973). (In German).

Studies done at the Radium Institute on nuclear reactions, in particular, angular correlation studies, are briefly recounted. Attention is directed to deuteron stripping reactions at low and medium energies. (RWR)

25584 ^{90,91}Zr PHOTOPROTON SPECTRA AND THE CORE-EXCITATION MODEL. Askin, H. J. (Univ. of Melbourne); Allen, K. J. F.; Thompson, M. N.; Shoda, K.; Sugawara, M.; Miyase, H.; Sung, B. N. Nucl. Phys.; A220: No. 2, 241-258(1973).

Photoproton energy spectra were measured for the ^{90,91}Zr(γ,p)^{89,90}Y reactions at an E_γ endpoint energy of 30 MeV, and for the ^{90,91}Zr(e,e′p)^{89,90}Y reactions at a number of different electron beam energies around E_e = 21 MeV. Isotopically enriched target foils of metallic ^{90}Zr(97.65%) and ^{91}Zr(89.2%) were used, and the proton spectra measured at 90°. Prominent proton groups are observed in the ^{91}Zr spectra, particularly around $E_p \approx 11$ MeV, which closely resemble groups produced in the ^{90}Zr photoreactions. Moreover, the correlating nonground state proton groups are produced in transitions leaving the corresponding ^{89}Y, ^{90}Y residual nuclei in excited levels which also correlate in energy. These photoproton groups from ^{90}Zr have previously been identified as representing $T_>$ strength. A qualitative explanation is proposed in terms of the core-excitation model, in which the structure in the ^{91}Zr proton spectrum is described as representing dipole $T_>$ ($T = {}^{13}\!/_{2}$) strength formed by coupling the $2d_{5/2}$ neutron to dipole $T_>$ ($T = 6$) excitations of a ^{90}Zr core. (auth)

25585 SYSTEMATIC FEATURES OF THE LOW-LYING LEVELS OF EVEN–EVEN NUCLEI NEAR THE CLOSED SHELL Z = 50. Hall, I.; Thomas, D. J. (Univ. of Liverpool). J. Phys., A (London); 7: No. 1, L8-L10(1 Jan 1974).

It was suggested that particle-hole symmetry may be responsible for level energy systematics in the Z ≃ 50 region but the measured quadrupole moments do not have a similar simple explanation. (auth)

25586 LEVELS IN THE N = 82 NUCLEUS ^{142}Nd. Smolka, F. M.; Pinho, A. G. (Pontifica Univ. Catolica, Rio de Janeiro). Rev. Brasil. Fis.; 2: No. 3, 215-224(Dec 1972).

Decays of both ^{142}Pr and ^{142}Pm to levels in the 82-neutron isotone ^{142}Nd were investigated with Ge(Li) detectors. The ^{142}Pm was not separated from the ^{142}Sm source and some ambiguity is present in the assignment of gamma-rays with energies up to 2.05 MeV. Spin and parity assignments were made for all levels. The resulting level scheme is compared with predictions of theoretical calculations. (auth)

25587 REACTION LIST FOR CHARGED-PARTICLE-INDUCED NUCLEAR REACTIONS Z = 1 TO Z = 98 (H TO Cf), JULY 1972–JUNE 1973. McGowan, F. K.; Milner, W. T. (Oak Ridge National Lab., TN). At. Data Nucl. Data Tables; 12: No. 6, 499-583 (15 Dec 1973).

This Reaction List for charged-particle-induced nuclear reactions was prepared from the journal literature for the period July 1972 through June 1973. Each published experimental paper is listed under the target nucleus in the nuclear reaction with a brief statement of the type of data in the paper. The nuclear reaction is denoted by A(a,b)B, where M_a ≥ (one nucleon mass). There is no restriction on energy. Nuclear reactions involving mesons in the outgoing channel are not included. Theoretical papers which treat directly with the analysis of nuclear reaction data and results are included in the Reaction List. (auth)

25588 NUCLEAR DATA SHEETS FOR A = 133. Henry, E. A. (Univ. of California, Livermore). Nucl. Data Sheets; 11: No. 4, 495-548(Apr 1974).

Nuclear structure data are compiled for the ten known members of the A = 133 mass chain. Decay and reaction data from approximately 200 references available through July 1973 are evaluated. Adopted level properties and gamma-ray properties are presented in summary form for each nucleus. Included are seven drawings, which show most of the decay properties and adopted values. Following the data section for each radioactive nucleus is a discussion of its decay scheme. Since data for short-lived members of the A-chain are limited and sometimes inconsistent, few definitive spin and parity assignments can be made for their daughter nuclei. (auth)

25589 QUADRUPOLE MOMENTS OF 8_1^+ STATES IN ^{92,94}Mo. Baba, C. V. K. (Univ., Munich); Fossan, D. B.; Faestermann, T.; Feilitzsch, F.; Loebner, K. E. G.; Signorini, C. Phys. Lett.; 48B: No. 3, 218-220(4 Feb 1974).

The ratio of the quadrupole moments of the 8_1^+ states in ^{92,94}Mo was measured as $Q(^{94}\text{Mo})/Q(^{92}\text{Mo}) = 1.48 \pm 0.12$ by means of the TD PAD method following the ^{90,92}Zr(α,2n)^{92,94}Mo reactions on enriched Zr metal foils. This ratio is consistent with the effective charge ratio for the $8^+ \rightarrow 6^+$ E2 transitions, which demonstrates a prediction of the effective charge concept. (auth)

25590 SHELL MODEL STUDY OF N = 50 NUCLEI. Gloeckner, D. H.; Serduke, F. J. D. (Argonne National Lab., IL). Nucl. Phys.; A220: No. 3, 477-490(1974).

Measured E2 and M4 transitions and energy levels in the N = 50 isotones with Z > 38 are satisfactorily reproduced by a shell model with proton configurations $(2p_{1/2}, 1g_{9/2})^n$. Four sets of two-body matrix elements are found by least-squares fitting to energy levels and transition rates in the N = 50 isotones. These interactions include one that exactly conserves seniority and another that fits the strongly inhibited $8^+ \rightarrow 6^+$ transition in ^{94}Ru. Slight seniority nonconservation is required to predict inhibited N = 50 transition rates. The sign of the off-diagonal matrix element is determined by comparison with experimental M4 rates. The seniority conserving interaction is found to be equivalent to the best seniority nonconserving interaction for prediction of energy levels. (auth)

25591 ELASTIC ELECTRON SCATTERING AT 30 TO 80 MeV FROM ^{142,146,150}Nd. Maas, R.; De Jager, C. W. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Phys. Lett.; 48B: No. 3, 212-214(4 Feb 1974).

The elastic electron scattering cross sections for ^{142,146,150}Nd were measured at momentum transfers between 0.2 and 0.8 fm^{-1}. The results do not support the anomalously small skin thickness values obtained in a previous low-energy electron scattering experiment. (auth)

25592 NUCLEAR DATA SHEETS FOR A = 105. Bertrand, F. E. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 11: No. 4, 449-494(Apr 1974).

The 1960 version of the Nuclear Data Sheets for A = 105 was revised on the basis of data received before November 1973. All literature containing nuclear structure data pertaining to A = 105 was reviewed and evaluated, resulting in the use of over 100 references. Nine nuclei, Nb(?), Mo, Tc, Ru, Rh, Pd, Ag, Cd, and In, are assigned as members of the mass chain. This A-chain is organized in four distinct parts, which appear in the following order: Drawings, Summary Sheets, Data Sheets (for some nuclei there are no separate Data Sheets), and References. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 23916, 25146, 25539, 25542, 25559, 25575, 25578, and 25591.

25593 (FRNC-TH-405) ROTATION-PARTICLE COUPLING IN GROUND STATE BANDS OF N = 107 ISOTONES: ^{179}Hf, ^{181}W, AND ^{183}Os; BEHAVIOR OF THE GROUND STATE BAND OF ^{182}Os. Bethoux, R. (Grenoble-1 Univ., 38 (France)). 1973. 70p. (In French). Dep. NTIS (U. S. Sales Only) $5.50.

Thesis.

The ^{183}Os nucleus was studied using γ ray beam spectroscopy techniques, the ^{182}W(α,3n)^{183}Os reaction being considered. The rotation–particle coupling of the ground-state band constructed on the $\frac{9}{2}^+$(624) intrinsic state was analyzed. The experimental results were used in a comparative analysis of properties connected with the structures of the ground-state bands of the three isotones ^{179}Hf, ^{181}W, and ^{183}Os in the framework of the same theoretical model. The model used gives a very good explanation of the rotational-level energies, moments of inertia, transition probabilities, and static magnetic moments in the ground-state bands, if the matrix elements between intrinsic states with $|\Delta K| = 1$ are reduced. The ground-state band of the ^{182}Os even nucleus excited by the ^{182}W(α,4n)^{182}Os reaction at 43 MeV was also studied. The existence of levels with high spins was established. The considerable departure from the I(I + 1) rotational law observed for these levels was analyzed in the framework of existing theoretical models. (FR)

25594 (JINR-E4-7596) CCBA CALCULATION FOR THE ^{154}Sm(d,p)^{155}Sm REACTION AT E_d = 12 MeV. Gareev, F. A.; Yamaeev, R. M.; Jaskola, M.; Kuchtia, I. N.; Schulz, H. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

The coupled channel Born approximation (CCBA) is applied to the description of the deuteron stripping on ^{154}Sm using deformed bound state wave functions which are expanded in terms of Sturmian functions. The optical parameters were adjusted by coupled channel calculations from elastic and inelastic scattering data. Most of the theoretically predicted angular distributions for the available transfers are in good agreement with the experimentally observed ones. (auth)

25595 ELECTROMAGNETIC TRANSITIONS OBSERVED IN β^+ DECAY OF ^{184}Hg AND ^{184}Pt. Cailliau, M.; Foucher, R.; Husson, J. P.; Letessier, J.; Richard-Serre, C. (Paris Univ., Orsay, France). Compt. Rend., Ser. A, B; 277: No. 19, 565-568(12 Nov 1973). (In French).

The energies and intensities of the principal transitions observed in ^{184}Hg → ^{184}Au (T(½) = 32.5 ± 10 s) and ^{184}Pt → ^{184}Ir (T(½) = 17.3 ± 0.2 mn) are given. Some results on coincidences and multipolarities are also presented. (tr-auth)

25596 CROSS SECTIONS OF NEUTRON RADIATIVE CAPTURE IN THE ENERGY RANGE 5 TO 70 keV FOR Gd AND Er ISOTOPES. Shorin, V. S.; Kononov, V. N.; Poletaev, E. D. (Physical Energy Inst., Moscow). Yadern. Fiz.; 19: No. 1, 5-10(Jan 1974). (In Russian).

Cross sections of neutron radiative capture are measured in the energy range 5 to 70 keV for the isotopes ^{154,155,156,157,158,160}Gd and ^{166,167,168,170}Er. The measurement method is based on the detection of instant capture γ rays applying the time-of-flight technique. The time resolution is 25 nsec/m. The relative capture cross section is normalized to the reaction ^{10}B (n,αγ). For the absolute normalization the Au capture cross section at the neutron energy of 30 keV was used. (auth)

25597 POPULATION OF HIGH SPIN STATES OF ^{160}Dy IN THE (^{7}Li, α2n) REACTION. Fenzl, M.; Imazato, J. (Technische Univ., Munich). Z. Phys.; 266: No. 2, 135-138(Jan 1974).

In-beam gamma spectra have been measured during the bombardment of ^{159}Tb with ^{7}Li of 28, 34, and 37 MeV incident energy. Levels with spin up to 12ħ in ^{160}Dy were strongly populated through the (^{7}Li, α2n) channel. (3 figures, 1 table) (auth)

25598 SPIN OF THE 1082.8-keV LEVEL IN ^{152}Sm. Gupta, S. L. (Vanderbilt Univ., Nashville); Garcia-Bermudez, G.; Lange, J.; Hamilton, J. H.; Ramayya, A. V.; Singhal, N. C.; Baker, K. R.; Johnson, N. R. Nucl. Phys., A221: No. 3, 541-545(1974).

The spin of the 1082.8-keV level in ^{152}Sm was measured as 0 by directional correlation experiments. Earlier, a level at 1081 keV was assigned a spin and parity of 1^- or 2^+ from the decay of ^{152}Pm. The present results indicate that either these two levels are different or the previously assigned 1081-keV ground-state transition is misplaced in the decay studies of ^{152}Pm. (2 figures, 1 table) (auth)

25599 CHARACTER OF THE HARTREE–FOCK–BOGOLYUBOV SOLUTIONS IN A ROTATING FRAME. Banerjee, B. (Scuola Normale Superiore, Pisa, Italy); Ring, P.; Mang, H. J. Nucl. Phys., A221: No. 3, 564-572(1974).

The nature of the solutions of the Hartree–Fock–Bogolyubov equations in a rotating frame is described. The significance of solutions which involve negative quasi-particle energy is discussed in detail. (1 figure) (auth)

25600 INTERNAL CONVERSION PROCESS OF ELECTRIC DIPOLE TRANSITIONS IN ^{180}Hf AND ^{182}W. El Nesr, M. S.; Bashandy, E. (Atomic Energy Establishment, Inshas, Egypt). Z. Phys.; 265: No. 4, 313-323(Nov 1973).

The conversion electron process of the retarded electric dipole transitions of 58 keV in ^{180}Hf and 67, 116, 152, 156, and 222 keV in ^{182}W have been studied by means of high-resolution double focusing beta-ray spectrometers. No penetration effects were found in the conversion process of the retarded 58 keV and 67, 116 and 222 keV E1 transitions, while the retarded 152 and 156 keV transitions in ^{182}W show an anomalous internal conversion ratio compared with theoretical values. Implications of the results for current nuclear theories are discussed. (6 figures, 1 table) (auth)

25601 LIFETIMES OF HIGH SPIN ROTATIONAL STATES. Kearns, F.; Dracoulis, G. D.; Inamura, T.; Lisle, J. C.; Willmott, J. C. (Univ. of Manchester, Eng.). J. Phys., A (London); 7: No. 1, L11-L15(1 Jan 1974).

Lifetimes were measured for Coulomb excited states with $8^+ \leq J^\pi \leq 12^+$ in even A isotopes of Dy, Er and Yb. A significant retardation in E2 transition rates for the decay of 12^+ states in ^{160}Dy, ^{162}Dy and ^{164}Er is observed. (auth)

25602 STRANGE BACKBENDING BEHAVIOR IN THE Yb ISOTOPES. Faessler, A. (Kernforschungsanlage, Juelich, Ger.); Gruemmer, F.; Lin, L.; Urbano, J. Phys. Lett; 48B: No. 2, 87-90(21 Jan 1974).

The rotational energies and the backbending behavior of ^{166,168,170}Yb are calculated utilizing angular momentum and particle number projected deformed BCS trial wave functions. The anomaly of the moment of inertia can be reproduced quantitatively with the moment of inertia of an inert core as the only free parameter. A possible explanation for the strange behavior in the Yb isotopes is given. (auth)

25603 NUCLEAR DEFORMATIONS IN ^{186}Hg FROM LIFETIME MEASUREMENTS. Proetel, D.; Diamond, R. M.; Stephens, F. S. (Univ. of California, Berkeley). Phys. Lett.; 48B: No. 2, 102-104(21 Jan 1974).

Using the recoil-distance Doppler-shift method, the half-lives of the 2^+, 4^+, 6^+ and 8^+ states in ^{186}Hg following the reaction ^{170}Yb (^{20}Ne,4n)^{186}Hg were measured. A strong enhancement of the $6^+ \rightarrow 4^+$ transition probability is found, $B(E2, 6^+ \rightarrow 4^+) = 1.9 \pm 0.8\ e^2b^2$, over the $2^+ \rightarrow 0^+$ value, $B(E2, 2^+ \rightarrow 0^+) = 0.28 \pm 0.05\ e^2b^2$. These results indicate that ^{186}Hg makes an angular-momentum-induced transition from nearly spherical to strongly deformed shapes. (auth)

25604 DEFORMATION PARAMETERS OF ^{152}Sm BY ELECTRON SCATTERING. Bertozzi, W. (Massachusetts Inst. of Tech., Cambridge). Kakuriken Kenkyu Hokoku; 5: 39-47(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendei, Japan (12 Sep 1972). See CONF-720907-.

Electrons with energies between 50 and 105 MeV were scattered from ^{152}Sm and measured at 93.5, 110, and 145°. The energy resolution of 0.08% allowed a clean separation of all rotational levels. The areas under the peaks were extracted by using a line shape fitting procedure accounting for radiative effects, Landau straggling, background, and the energy distribution of the incident beam. A deformed Fermi distribution was used for the intrinsic shape of ^{152}Sm. Calculated form factors for the excitation of the ground-state rotational band are shown. A skin thickness varying as the radius was definitely ruled out. The results obtained are compared with those found by other investigators. (3 figures) (RWR)

25605 NUCLEAR DATA SHEETS FOR A = 171. Horen, D. J.; Harmatz, B. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 11: No. 4, 549-602(Apr 1974).

The experimental data for nuclei in the mass chain A = 171 were examined; and the results summarized. The compilers have deviated somewhat from standard Nuclear Data Sheet practices. They have done so by excluding some symbols normally included in drawings (e.g., coincidence dots), and by minimizing the effort devoted to the data per se, and concentrating on only those data needed to summarize the present status of the physics involved. Of the ten nuclei identified thus far in this mass chain, the data yield considerable information pertaining to the low-lying structure of ^{171}Yb and ^{171}Lu. For these nuclei, many of the expected Nilsson states (and rotational bands) have been established. The probable decay of ^{171}Ta (supposedly $^7/_2{}^+$[404]) to members of the $^1/_2{}^-$[521] band in ^{171}Hf is somewhat puzzling. It is hoped that the present compilation might serve as a basis for choosing definitive experiments that would augment knowledge of nuclei in this mass chain. Data received prior to November 1973 were included. (auth)

Nuclear Properties and Reactions, $190 \leq A \leq 219$

Refer also to abstracts 24282, 25236, 25536, 25542, 25556, 25557, 25572, 25611, 25613, 25618, 25629, and 25643.

25606 (FRNC-TH-444) STUDY OF (^{3}He,xn), (^{3}He,pxn), AND (^{3}He, FISSION) NUCLEAR REACTIONS ON ^{206}Pb BETWEEN 80 AND 205 MeV. Andre, C. (Paris-11 Univ., 91-Orsay (France)). 1973. 55p. (In French). Dep. NTIS (U. S. Sales Only) $4.75. Thesis.

Excitation functions corresponding to a large number of reactions induced by ^{3}He^{++} on ^{206}Pb nuclei were studied. Various techniques were used in these experiments (activation methods; the He jet method) for the detection and measurement of light α-particle-emitting polonium isotopes having very short half-lives. Solid track detectors were employed for fission studies. All the information obtained (on the (^{3}He,xn) and (^{3}He,pxn) excitation functions, on fission, and on the isomeric ratios) demonstrates that reactions induced by ^{3}He above 100 MeV rarely proceed by the compound nucleus mechanism. In addition, the number of such cases occurring rapidly diminishes with increasing incident energy. In this way, the important contribution of noncompound processes was demonstrated, and, in particular, the fission occurring after the direct interaction mechanism. A comparison with ^{206}Pb(α,X) reactions revealed that, for equal nucleon velocities, the contribution from direct reactions is greater for ^{3}He than for α particles as a result of the smaller binding energy of ^{3}He. These results also demonstrate that charged particle emission is of considerable importance. If the (^{3}He,xn) reactions (2% of σ_R) are neglected at 200 MeV, it is observed that (^{3}He, charged part., xn) and (^{3}He, fission) reactions represent $^2/_3$ and $^1/_3$, respectively, of the total cross section of the reaction (3 barns). (FR)

25607 (JINR-P6-7581) DECAY SCHEME OF ^{193}Tl. Vandlik, T. B.; Vandlik, Ya.; Zaitseva, N. G.; Mate, Z.; Makhunka, I.; Makhunka, M.; Tyrroff, Kh.; Fenesh, T.; Fominykh, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

γ-, conversion-electron and $\gamma\gamma$-coincidence spectra from the decay of ^{193}Tl monoisotope preparations were measured with Ge(Li) and Si(Li) detectors. There were 48 γ-transitions observed, from which 40 are new. The multipolarity of 19 transitions, the half-life and ϵ/β^+ branching rate of ^{193}Tl were also determined. The proposed ^{193}Tl decay scheme contains the following new levels: 50.0 keV $(^1/_2)^-$; 324.4 keV $(^3/_2)^-$; 374.6 keV $(^3/_2, {}^5/_2)^-$; 752.5 keV $(^3/_2, {}^5/_2, {}^1/_2)^-$; 1523.4 keV $(^3/_2, {}^5/_2, {}^1/_2)^-$ and 1580.0 keV. (auth)

25608 A 6.1 s ISOMER AND ROTATIONAL BANDS IN ^{192}Os. Pakkanen, A.; Heikkinen, D. W. (Jgvaeskylae Univ., Finland). Phys. Fenn.; 8: No. 4, 345-356(Dec 1973).

A 6.1 ± 0.2 s activity has been observed when natural Os targets were bombarded with 14.5 MeV neutrons. The activity is assigned to the decay of a high-spin isomer in ^{192}Os at 2015.4 keV, which is depopulated by M2 and E3 transitions. Singles and coincidence γ-ray spectra have allowed the identification of seven new states in ^{192}Os. Several of these levels have been placed in either the ground-state or γ-vibrational bands, which are strongly mixed. Excitation energies, B(E2) ratios for these bands are compared with different theoretical models. (auth)

25609 NEED FOR LONG RANGE COMPONENTS IN THE EFFECTIVE NUCLEAR INTERACTION. Golin, M.; Sharp, R.; Zamick, L. (Rutgers—The State Univ., New Brunswick, NJ). Nucl. Phys., A221: No. 3, 546-554(1974).

It is shown that, if one uses single-particle energies from experiment and a delta residual interaction, it is not possible to obtain the energy of the giant dipole and spurious states of ^{208}Pb, and at the same time obtain reasonable results for the low-lying two-particle spectra of ^{210}Pb or ^{210}Po. Related to the above problem, the isobaric analog state of ^{208}Pb (in ^{208}Bi) comes much too low in calculations using realistic interactions. It is noted that the above difficulties can be overcome, phenomenologically at least, by adding to the effective interaction some long-range repulsive components. The Bansal—French and the Schiffer interactions are examples of these; however, the dipole—dipole component of the Schiffer interaction gives much too large a splitting between the dipole state and spurious state. (auth)

25610 STATIC MOMENTS OF THE FIRST EXCITED STATES OF ^{32,34}S AND ^{204,206}Pb. Olin, A.; Haeusser, O.; Alexander, T. K.; Ferguson, A. J.; Witthuhn, W. (Chalk River Nuclear Labs., Ont.). Nucl. Phys., A221: No. 3, 555-563(1974).

The reorientation effect in Coulomb excitation was used to measure the following static quadrupole moments: $Q_{2+}(^{32}S) = -0.066 \pm 0.017$ b, $Q_{2+}(^{34}S) = 0.026 \pm 0.023$ b, $Q_{2+}(^{204}Pb) = 0.19 \pm 0.14$ b. Interference effects from higher excited states were included in the analysis, with the signs of the E2 matrix elements taken from an anharmonic model. The value obtained for $Q_{2+}(^{32}S)$ is in disagreement with two previous measurements. The discrepancy is attributed to the smaller internucleon separation distances involved in the previous experiments, which can cause deviations from Coulomb excitation cross sections. The other quadrupole moments have not been measured previously. The $B(E2: 0^+ \rightarrow 2^+)$ measured were $0.0305 \pm 0.0016\ e^2 \cdot b^2(^{32}S)$, $0.025 \pm 0.004\ e^2 \cdot b^2(^{34}S)$, and $0.166 \pm 0.009\ e^2 \cdot b^2(^{204}Pb)$. From the angular distribution of the de-excitation γ rays of the Pb nuclei following recoil into vacuum, the following g factors were determined: $|g_{2+}(^{204}Pb)| < 0.08$ (two standard deviations), $|g_{2+}(^{206}Pb)| = 0.07$[illegible]. The value of $g_{2+}(^{206}Pb)$ is in agreement with a previous measurement. (5 figures, 2 tables) (auth)

25611 ELEMENTARY MODES OF EXCITATION IN THE ^{204}Pb(t,p)^{206}Pb REACTION. Flynn, E. R. (Los Alamos Scientific Lab., NM); Broglia, R. A.; Liotta, R; Nilsson, B. S. Nucl. Phys., A221: No. 3, 509-527(1974).

The ^{204}Pb(t,p)^{206}Pb reaction was performed at a bombarding energy of 20 MeV. Angular distributions for levels up to 8 MeV of excitation were obtained by using solid-state counters and a magnetic spectrograph. A strong correlation was found between the recorded ^{206}Pb spectrum and the spectrum observed in the ^{206}Pb(t,p)^{208}Pb, ^{207}Pb(t,p)^{209}Pb, and ^{208}Pb(t,p)^{210}Pb reactions. This correlation provides further support for the existence of multipole pairing quanta. These elementary excitations together with multipole surface modes can then be viewed as the basic building blocks of the spectrum around the closed-shell nucleus ^{208}Pb. (5 figures, 7 tables) (auth)

25612 POSSIBILITY FOR THE DETERMINATION OF THE CRITICAL ENERGY OF THE PHASE TRANSITION OF PREACTINIDE NUCLEI. Okolovich, V. N.; Itkis, M. G.; Kuvatov, K. G.; Rus'kina, G. Ya. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 21-26(1973). (In Russian).

A method was proposed for the determination of the energy of the phase transition of the preactinide nucleus from the energy dependence of the persistent and neutral widths. Data were given on the cross sections of ^{208}Pb, ^{210}Po, ^{212}Po, ^{196}Hg, and ^{198}Hg measured in the energy range of the α particles from 29 to 46 MeV. (tr-auth)

25613 ELECTROMAGNETIC TRANSITION RATES IN ^{215}Po. Bowman, J. D. (Institut fuer Strahlen- und Kernphysik, Bonn); Ley, L.; Richter, B. Nucl. Phys.; A220: No. 2, 367-380(1974).

The half-lives of the excited levels at 272 and 402 keV in ^{215}Po were measured by the delayed coincidence and α-recoil Doppler shift attenuation methods to be 195(15) ps and 66(5) ps, respectively. Reduced electromagnetic transition probabilities are deduced. The results are interpreted in terms of the core excitation model. (auth)

25614 SHELL-MODEL ANALYSIS OF INELASTIC SCATTERING FROM ^{208}Pb. Arita, K. (Aoyama Gakuin Univ., Tokyo); Terasawa, T. Kakuriken Kenkyu Hokoku; 5: 115-120(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendai, Japan (12 Sep 1972). See CONF-720907-.

Transition charge densities between the ground and the low-lying 3^-, 5_1^-, and 5_2^- states in ^{208}Pb and the corresponding form factors were calculated by using harmonic oscillator single-particle wave functions. The zeroth-order configurations were assumed to be the closed shell for the ground state and 1p—1h ones with energies below 7 MeV for the excited states; in this configuration space the Hamiltonian with True's residual interaction was diagonalized. Then the effect of higher configurations was estimated by first-order perturbation theory. Several perturbation interactions with different exchange characteristics were examined. The effect of multiplying the transition charge density by a density-dependent factor was also investigated. (4 figures, 2 tables) (RWR)

25615 COUPLING PHENOMENA BETWEEN $\sigma = 0$ AND $\sigma = 1$ CHARGE EXCHANGE DIPOLE MODES. Civitarese, O. (Univ. Nacional, La Plata); Krmpotic, F.; Szybisz, L. Phys. Lett., 48B: No. 3, 199-202(4 Feb 1974).

The observed large E1 width of the isobaric analog state in ^{209}Bi is found to be inconsistent with the β decay of ^{210}Bi. (auth)

25616 DETERMINATION OF THE NEUTRON HALO FROM ANTIPROTON ABSORPTION. Leon, M. (Los Alamos Scientific Lab., NM); Seki, R. Phys. Lett.; 48B: No. 3, 173-175(4 Feb 1974).

The size of the neutron halo in Pb implied by the recent $\bar{p}$-annihilation experiment of Bugg et al. was examined. It was found that the answer depends sensitively on the strong-interaction parameters determined by $\bar{p}$ x-ray experiments. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 24284, 24381, 25511, 25536, 25587, 25613, 25634, 25639, 25647, and 26106.

25617 (COO-3058-39, pp 9-15) PROMPT NEUTRON MULTIPLICITY MEASUREMENTS FOR NEUTRON-INDUCED FISSION OF ^{233}U AND ^{235}U. Reed, R. L.; Hockenbury, R. W.; Block, R. C. [nd].

In linear accelerator project. Annual technical report, October 1, 1972–September 30, 1973.

25618 (FRNC-TH-441) ATTEMPT TO IDENTIFY THE γ RAY SPECTRA OF SOME NATURAL RADIOISOTOPES OF THE THORIUM FAMILY. Dalmasso, J. (Nice Univ., 06 (France)). 1972. 398p. (In French). Dep. NTIS (U. S. Sales Only) $22.00. Thesis.

Coincidence and sum measurements were made of the γ spectra of ^{228}Th and its derivatives, a germanium detector being used for the purpose. A partial scheme is proposed for the excited levels of ^{228}Th. The coincidence windows providing the most information were 900 ± 20 and 969 ± 20 keV, 330 ± 20, 270 ± 20, and 209 ± 20 keV. The energy and intensity of the sum structures observed are given. The results of the coincidence measurements made led to the establishment of the existence of 33 levels which, in turn, led to a univocal interpretation of 127 transitions; 8 transitions were interpreted in two different ways. The sum rules suggest the existence of other levels for the interpretation of weak transitions. The decay schemes of ^{228}Ac and ^{228}Pa are compared using ^{228}Th. Studies of the γ radiation from ^{228}Th and its derivatives led to the establishment of the existence of 49 γ ray emissions between 80 and 2860 keV. In addition to the γ radiation from the isotopes of the active deposit, radiation due to ^{224}Ra and ^{220}Rn was observed. The most intense radiations belong to ^{212}Bi, ^{212}Po, and ^{208}Pb nuclei. It was possible to determine the energy of a certain number of transitions and nuclear levels in the decay of ^{220}Rn, ^{212}Bi, and ^{208}Tl. In addition, this study enabled the radiation from ^{228}Th + derivatives to be subtracted from the radiation of ^{228}Ra + derivatives, this process being exceedingly complex. (FR)

25619 (IFA-CRD-54-1973) FISSION ISOMERS, ELEVEN YEARS OF EXPERIMENTAL WORK. Poenaru, D. N. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 78p. Dep. NTIS (U.S. Sales Only) $6.00.

Spontaneous fission from an isomeric state of a transuranium nucleus was discovered in 1961, and since that time was intensively studied by experimenters. Many theoretical results were also obtained, but this review is concerned only with experimental work. After the description and classification of techniques used in this field, the experimental trends, the methods of investigation, and some particular results are presented. Separate sections are reserved for double fission isomers, lifetime systematics, and excitation energy systematics. The study of nuclear reactions by which the fission isomers are excited provides the main source of information about these isomers. Nuclear reactions induced by charged particles, neutrons, and gamma rays are described. Then some explanations concerning the nature of fission isomers are qualitatively discussed. The last section is devoted to some problems interesting for future research. By arranging the references in a chronological order, the chronology can be established relatively easily. (40 figures, 7 tables, 110 references) (auth)

25620 (IFA-NR-47-1973) ABSOLUTE MEASUREMENT OF ^{235}U FISSION CROSS-SECTION FOR 2200 M/SEC NEUTRONS. Borcea, C.; Borza, A.; Buta, A. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 19p. Dep. NTIS (U.S. Sales Only) $3.00.

The results of an absolute fission cross-section measurement of ^{235}U are presented; the thermal neutrons were selected by the time-of-flight method. The principle of the method and the experimental apparatus are described. The method had the advantage of avoiding the use of an intermediate cross section in the neutron flux determination by choice of a B target thick enough to absorb all thermal neutrons. Target preparation, efficiency determination, corrections, etc., are reported. The value determined was 581.7 ± 7.8 barns. (6 figures, 4 tables) (RWR)

25621 (IFA-NR-49-1973) RECURRENCE FORMULA FOR COMPUTING ^{235}U NEUTRON FISSION CROSS SECTION. Mihailescu, I. M. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 14p. Dep. NTIS (U.S. Sales Only) $3.00.

Obtained by using a rank annihilation technique, a recurrence formula for computing the level matrix elements is given. The neutron fission cross-section multilevel expression for many fission channels is obtained. The iteration procedure depends on the number of open fission channels. By assuming the interference between six resonance levels at positive energy, of the same spin and parity, and two open fission channels, the ^{235}U fission cross section values were computed for neutron energies less than 2 eV. The contribution from two bound levels was taken into account according to the Breit–Wigner formula. The fission cross-section curve was drawn in a figure, and a very good fit to that computed with a Reich–Moore multilevel formula for two fission channels was obtained. (2 figures, 1 table) (auth)

25622 (JINR-P6-7588) EXPERIMENTS ON SEARCH FOR SPONTANEOUSLY FISSIONING NUCLIDES OF SUPERHEAVY ELEMENTS IN NATURE. I. Flerov, G. N.; Ter-Akop'yan, G. M.; Skobelev, N. K.; Popeko, A. G.; Ivanov, M. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 25p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

After analyzing various methods applied in the search for superheavy elements in nature, it is shown that the method based on the recording the rare events of spontaneous fission in samples is one of the most sensitive and universal. Large proportional counters for fission fragments and neutron detectors for multiple neutron emission are described. The upper limits for the superheavy element concentration in the samples of the bismuth hydroxide (2.5×10^{-13} g/g), lead ($4 \times 10^{-15}-5 \times 10^{-16}$ g/g), mercury ($1.4 \times 10^{-14}-1.4 \times 10^{-15}$ g/g and tungsten ($1.4 \times 10^{-14}-2.5 \times 10^{-15}$ g/g) were determined under the condition that the half-life of the element under search is equal to 10^{9} years. (auth)

25623 (ORNL-tr-2805) BETA AND GAMMA ACTIVITY OF ONE FISSION OF ^{235}U AND ^{239}Pu. II. Comparison with Experimental Results. Costa, L.; de Tourreil, R. Translated by Martha Gerrard from J. Nucl. Energy; 25: 285-295(1971). 11p. Dep. NTIS $3.00.

A comparison is presented of the different experimental measurements on the disintegration rates and residual beta and gamma energies with theoretical predictions obtained from properties of the fission products in the most sensitive case of a single thermal fission of ^{235}U and ^{239}Pu. It was concluded that even in the best studied case (^{235}U) the divergences among the different experimental results are considerably greater than the estimated errors, this being due to difficulties of normalization, and the theoretical results obtained starting with the fission product properties have a precision better than 30 and 15%, respectively, for residual beta and gamma energies for cooling times of $10^2 \leq \tau \leq 10^3$ s and better than several percent for the same residual energies when $\tau > 10^3$ s. (3 figures, 3 tables) (auth)

25624 (WAPD-TM-1129) ^{233}U FISSION NEUTRON SPECTRUM FROM 0.8 TO 10 MeV (LWBR DEVELOPMENT PROGRAM). Green, L.; Mitchell, J. A.; Steen, N. M. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Dec 1973. Contract AT(11-1)-Gen-14. 14p. Dep. NTIS $3.00.

The ^{233}U fission neutron spectrum was measured by pulsed-beam time-of-flight techniques from 0.8 to 10 MeV. Above approximately 2 MeV the data were found, within statistics, to be adequately represented by either the model in the ENDF/B-III file or a best fit Maxwellian with nearly the same average energy. At lower energy the data appear to follow the ENDF/B-III representation somewhat more closely. A Maxwellian fit to a single set of data taken for ^{235}U yielded a "temperature" parameter of 1.305 ± 0.006 MeV. The "temperature" for the ^{233}U run taken under nearly identical experimental conditions was 1.321 ± 0.002 MeV (statistical errors only). The best estimate of the Maxwellian "temperature" difference between the two spectra is, therefore, 16 ± 6 keV. (9 figures, 1 table) (auth)

25625 DECAY OF 8.7 MIN ^{237}Pa. Kaffrell, N.; Trautmann, N.; Denig, R. (Univ., Mainz). Z. Phys.; 266: No. 1, 21-27(1974).

The beta and gamma radiations of ^{237}Pa have been investigated employing semiconductor and scintillation spectrometers and coincidence techniques. Sources of ^{237}Pa were obtained after bombardments of ^{238}U with bremsstrahlung and 14-MeV neutrons and subsequent chemical separation. From the total of 18 γ-rays following the decay of 8.7 ± 0.2 min ^{237}Pa 17 transitions, representing 99.9% of the γ-ray intensity, could be placed in a level scheme of ^{237}U. A Q_β-value of 2.25 ± 0.1 MeV has been determined. (7 figures, 3 tables) (auth)

25626 SUPERHEAVY ATOMS AND NUCLEI. Armbruster, P. J.; Prange, H. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Ger.). Recherche (Paris); 4: No. 37, 751-759(Sep 1973). (In French).

It is demonstrated how the use of heavy ion beams in nuclear physics has opened up an entirely new domain of research permitting the possibility of fusing two nuclei in order to produce superheavy elements. Theoretically, stable nuclei with atomic numbers in excess of 110 exist. (FR)

25627 TWO NEW ISOTOPES OF EINSTEINIUM ^{243}Es AND ^{244}Es. Eskola, P.; Eskola, K.; Nurmia, M.; Ghiorso, A. (Univ. of California, Berkeley). Phys. Fenn.; 8: No. 4, 357-363(Dec 1973).

Two isotopes of einsteinium, ^{243}Es and ^{244}Es, were studied by means of α-particle spectroscopy. The isotopes were produced by bombarding a ^{233}U target with ^{15}N ions accelerated by the Berkeley HILAC. The half-lives and the α-particle energies of the two nuclides were observed to be: ^{243}Es 21 ± 2 s, 7.89 ± 0.02 MeV, ^{244}Es 37 ± 4 s, and 7.57 ± 0.02 MeV. The mass assignments are based on excitation function measurements and in the case of ^{244}Es on the genetic link to its EC daughter ^{244}Cf. Estimates for the EC branching of ^{243}Es and ^{244}Es are given. (auth)

25628 EFFECTIVE HALF-LIFE OF CALIFORNIUM-252. Spiegel, V. (National Bureau of Standards, Washington, DC). Nucl. Sci. Eng.; 53: No. 3, 326-327(Mar 1974).

The effective half-life of ^{252}Cf was determined as 2.638 ± 0.007 yr. The method utilized the ratio of the manganese activity induced in a manganous sulfate bath by a ^{252}Cf spontaneous-fission neutron source and the National Bureau of Standards photo-neutron source to measure the change in emission rate of the ^{252}Cf source over a period of 1.77 half-lives. The data were corrected for the activity of radium (1622-yr half-life) in the photoneutron source (– 0.2%) and for the competing neutron production from ^{250}Cf. (auth)

25629 STUDY OF γ RADIATION FROM ^{228}Th AND ITS DAUGHTER PRODUCTS, AND IN PARTICULAR FROM THALLIUM 208(ThC″). Dalmasso, J.; Maria, H.; Ythier, C. (Univ., Nice). Compt. Rend., Ser. A, B; 277: No. 16, 467-470(22 Oct 1973). (In French).

Studies of ^{228}Th in equilibrium with its daughter products enabled the existence of 4 new γ emissions to be established. It is likely that these emissions can be assigned to ^{208}Pb. The energy levels of several nuclei, in particular ^{208}Pb, were specified. (tr-auth)

25630 FISSION OF HEAVY NUCLEI. Petrshak, K. A. (Inst. of Radium, Leningrad). Isotopenpraxis; 9: No. 11/12, 402-406 (1973). (In German).

Work at the Institute of Radium on the fission of heavy nuclei in the low- and intermediate-energy range from the discovery of fission up to the present is briefly reviewed. Comments on the mechanism of fission are made. (RWR)

25631 CROSS SECTION AND ANGULAR ANISOTROPY OF THE ^{249}Cf FISSION IN THE NEUTRON ENERGY RANGE 0.5 TO 7.0 MeV. Fursov, B. I.; Ivanov, V. I.; Smirenkin, G. N. (Physical Energy Inst., Moscow). Yadern. Fiz.; 19: No. 1, 50-53(Jan 1974). (In Russian).

The cross section of ^{249}Cf fission is measured relative to the cross section of ^{239}Pu fission. The fragments were detected by the cylindrical glass detectors. The reactions T(p,n)^{3}He and D(d,n)^{3}He produced by means of electrostatic accelerators were used as a source of neutrons. The fission cross section for ^{249}Cf in the "plateau" region has the shape of a falling curve, which fact is explained due to decrease of the ratio of mean fission and neutron widths Γ_f/Γ_n with increase of the neutron energy. The anomaly of the threshold of the (n,n′f) reaction and the correlation of its position with the height of the barrier B are indicated. (auth)

25632 POSSIBLE SYNTHESIS OF ISOTOPES OF TRANSURANIUM ELEMENTS IN REACTIONS OF PARTIAL FUSION WITH HEAVY IONS. Artyukh, A. G.; Volkov, V. V.; Gridnev, G. F.; Il'inov, A. S.; Mikheev, V. L. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 19: No. 1, 54-61(Jan 1974). (In Russian).

Estimates are presented for production cross sections for isotopes of elements with $94 \leq Z \leq 100$ at exposition of ^{238}U to the ^{22}Ne ions with energy 172 MeV and to the ^{40}Ar ions with energies 288 and 379 MeV. The estimates are done based on analysis of experimental data on the cross sections and energy spectra of light products of multinucleon transfer reactions. (auth)

Nuclear Theory

Refer also to abstracts 25151, 25289, 25295, 25522, and 25574.

25633 (ANU-P-583) PROBABILITY DISTRIBUTIONS FOR THE HEIGHTS OF MAXIMA AND MINIMA IN FLUCTUATING CROSS SECTIONS. Branford, D.; Newton, J. O. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Dec 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

Probability distributions for the heights of maxima and minima in fluctuating cross sections have been obtained from synthetic excitation functions. It is shown how these can be used for determining to what extent experimentally observed large excursions from the average cross sections deviate from the predictions of simple fluctuation theory. Problems associated with determining the presence of resonance anomalies in experimental excitation functions are discussed. (auth)

25634 (CEA-CONF-2453) NUCLEAR PHYSICS TODAY AND TOMORROW. Gillet, V. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France)). 1973. 40p. (In French). (CONF-730574-10). Dep. NTIS (U. S. Sales Only) $4.00.

From Congress on the centenary of the French Physics Society; Vittel, France (28 May 1973).

In order to illustrate problems of current interest and new directions in nuclear physics, a few examples are chosen in the field of heavy-ion physics and nuclear reactions with high-energy particles: the search for nuclear species, investigation of shape isomerism in light and heavy nuclei, study of few-nucleon substructures in nuclei, direct evidence for intrinsic states, and meson current and baryon resonance effects in nuclei. (16 figures) (auth)

25635 (COO-3235-30) NUCLEAR EXCITATIONS AND REACTION MECHANISMS. Report of Progress to 31 October 1973. (Brown Univ., Providence, R. I. (USA). Dept. of Physics). 1 Nov 1971. Contract AT(11-1)-3235. 24p. Dep. NTIS $3.25.

Research on nuclear excitations and reaction mechanisms is summarized. A list of publications is included. (JFP)

25636 (ITF-73-147-P) ASYMPTOTIC EQUALITY OF DIFFERENTIAL CROSS SECTIONS IN THE FORM OF DIFFERENCE. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 8p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The estimates are obtained of the decreasing rate of difference of differential cross sections of the direct and cross reactions under the various restrictions imposed on the phase of the antisymmetric part of amplitudes of these reactions. (auth)

25637 (JINR-P2-7578) PRIMAKOV EFFECT AND POLARIZATION EFFECTS IN COHERENT UNSTABLE PARTICLE PRODUCTION. Vanzha, A. P.; Lapidus, L. I.; Tarasov, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Polarization effects due to the interference between hadronic and spin dependent Primakoff amplitudes are studied for the coherent production of unstable particles. The processes $N + Z \rightarrow N\,(1470) + Z$ and $\pi + Z \rightarrow A_1 + Z$ are considered in detail. Equations are obtained for the polarization, helicity amplitudes, cross sections and density matrix elements. (LBS)

25638 (JINR-P4-7639) MODEL FOR THE DESCRIPTION OF THE STRUCTURE OF HIGHLY EXCITED STATES IN DEFORMED NUCLEI. II. Exclusion of Superfluous Solutions. Malov, L. A.; Solov'ev, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 28p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

The model for the description of states of intermediate and high excitation energies was further developed. A new approximation method for solution of basic equations of the model was proposed which allowed to exclude superfluous roots appeared earlier when taking into account only coherent members of equation. The comparison between exact and approximation solutions demonstrates that the main components of the wave function are correctly expressed with the approximation solution. This enables one to study the fragmentation process of one- and many-particle states over nuclear levels in deformed nuclei. (auth)

25639 (RLO-1388-661) VISCOSITY IN THE FISSION PROCESS. Schuette, G.; Wilets, L. (Washington Univ., Seattle (USA). Dept. of Physics). 1973. 8p. (CONF-730823-23). Dep. NTIS $3.00.

From 3rd symposium on physics and chemistry of fission; Rochester, New York, USA (13 Aug 1973).

The fission process is often described in the adiabatic limit. The dynamical path is determined by an adiabatic potential energy surface and kinetic energy with mass parameters calculated by the cranking model. A model calculation for even–even nuclei is performed to study deviations from adiabaticity. The Hamiltonian consists of the sum of a time-dependent Nilsson-type Hamiltonian, the deformation parameter of which is either a prescribed linear or oscillating function of time or is determined by energy conservation in the mean, a pairing force of the BCS type between time reversed Nilsson states, and a small residual interaction between quasi-particle states, the matrix elements of which have random sign. There is no interaction between states of different isospin (n-p). In the calculations, the Hilbert space is limited to the BCS ground state and a limited number of two-quasi-particle excitations corresponding to the lowest energies of excitation at each deformation. Within this space, the time-dependent Schroedinger equation is solved numerically. The difference between the expectation value of the Hamiltonian and the cranking-model expression for the collective energy can be interpreted as viscous heat only as long as this difference is small. Calculations were performed for calcium and uranium. (6 figures) (auth)

25640 (RLO-1388-668) FISSION: THEORY AND BEYOND (A STUDY OF COLLECTIVE DYNAMICS). Wilets, L.; Haff, P. K. (Washington Univ., Seattle (USA); California Inst. of Tech., Pasadena (USA)). 1973. 4p. (CONF-730982-1). Dep. NTIS $3.00.

From correlation on nuclei conference; Lake Balaton, Hungary (3 Sep 1973).

The topic of the dynamics of the fission process has two subdivisions, the determination of the inertial mass parameters and the study of deviations from adiabaticity, excitation of single-particle levels, viscosity, etc. The problems of dynamics are studied, with attention directed to the role of nuclear correlations. Two alternate forms for the mass parameter are presented. The first is variational, but it requires the evaluation of matrix elements involving the Hamiltonian. The other does not involve the Hamiltonian, but rather it utilizes the physical content of the wave function. (1 figures) (RWR)

25641 DISTANT-LEVEL BACKGROUND CONTRIBUTION TO CHARGED-PARTICLE ELASTIC SCATTERING BY EVEN–EVEN NUCLEI. Comsan, M. N. H. (Atomic Energy Establishment, Inshas, Egypt). Atomkernenergie; 22: No. 2, 95-97(Oct 1973).

Explicit expressions for the differential cross section of charged particles scattered elastically by even–even nuclei are deduced. The expressions are based on the isolated-resonance approximation of the R-matrix theory. Background contribution in the form of hard-sphere scattering plus correction term to account for the effect of distant levels is introduced. The expressions can be easily adapted for the use of electronic computers. (1 figure) (auth)

25642 EFFECT OF TWO-BODY CORRELATIONS ON SUM RULES FOR NUCLEAR CHARGE MONOPOLE AND DIPOLE MODES. Lane, A. M. (Atomic Energy Research Establishment, Harwell, Eng.); Mekjian, A. Z. Phys. Rev., C; 8: No. 6, 1981-2006(Dec 1973).

Energy- and non-energy-weighted sum rules (N and M) were evaluated for the nuclear charge monopole and dipole modes. Sums are given for different intermediate isospins by using the method in which sums are split into isoscalar, vector, and tensor parts. This facilitates the separation of model-dependent quantities; in particular, possible modifications of shell-model evaluations arising from correlations are considered. Four important specific results are the following: (i) The shell-model value of M in the dipole case is carefully calculated for ^{208}Pb, and is 30% larger than the observed value; this difference must arise from correlations. (ii) The previously suggested smallness of the isotensor part of M is not general, but depends on using a shell-model wave function; it is shown theoretically and from experiment that the isotensor part may be large. (iii) The effects of correlations on M can be displayed in a form requiring no new calculations (given published Tamm–Dancoff diagonalizations). (iv) There is a close relation between the charge–exchange part of N in the dipole and monopole problems, so one can use data on the former to evaluate the latter; also, a connection with the effective M1 charge and effective mass is shown. (5 tables) (auth)

25643 INTERNAL IONIZATION DURING ALPHA DECAY: A NEW THEORETICAL APPROACH. Hansen, J.S. (Cyclotron Institute, Texas A&M University, College Station, Texas 77843). Phys. Rev. A 9: No. 1, 40-43 (Jan 1974).

A new theoretical treatment of the problem of orbital-electron ejection during α decay is described. The internal-ionization probability appears as the special zero-impact-parameter trajectory in a generalized impact-parameter formulation of the binary-encounter approximation described recently by the author. The probability of internal ionization during α decay of ^{210}Po is calculated for the 1s, 2s, 2p, 3s, 3p, and 3d subshells in the daughter Pb atom. Markedly improved agreement with experimental results is found. (auth)

25644 NUCLEAR SIZES AND THE OPTICAL MODEL. Jackson, D. F. (Univ. of Surrey, Guildford, Eng.). Rep. Progr. Phys.; 37: No. 1, 55-146(1974).

The study of the nuclear scattering of strongly interacting elementary particles including nucleons, pions and anti-protons and of composite particles, and the interpretation of this scattering in terms of the optical model, is reviewed. The complications surrounding the interpretation of nuclear size information from scattering data are discussed and an indication is given of the areas of confidence and uncertainty in the determination of size parameters. The current state of knowledge on the nuclear matter distribution and particularly the neutron distribution, as obtained from theoretical approaches, Coulomb energy differences and nuclear scattering is reviewed. (auth)

25645 WOULD ALPHA MATTER BE SOLID? Clark, J. W. (Washington Univ., St. Louis); Chao, N. C.; Kaellman, C. G. Phys. Fenn.; 8: No. 4, 335-344(Dec 1973).

Evidence, based on Cole's hard-sphere analysis of the laboratory quantum solids and on de Boer's quantum-mechanical principle of corresponding states, is presented that alpha matter in its lowest state would be solid, with a density perhaps one-half to two-thirds that of saturated nuclear matter. An heuristic interpretation of certain states of light nuclei as microcrystals of alpha matter–or a similar, more durable substance–is suggested. (auth)

25646 MECHANISM OF THE SINGLE-NUCLEON KNOCK-OUT REACTION INDUCED BY PIONS AT MEDIUM ENERGIES. Liu, L. C.; Huguenin, P. (Univ. of Neuchatel, Switzerland). Helv. Phys. Acta; 46: No. 2, 201-212(15 Aug 1973).

A model for the knock-out reaction induced by pions at medium energies is proposed. In this model, the pion is treated as a strongly absorbed particle and the effect of nuclear binding is included in a simple way. Good agreement with experiment is obtained. (auth)

25647 REPORT ON THE INTERNATIONAL CONFERENCE ON NUCLEAR PHYSICS IN MUNICH. Leuthaeuser, K. D. Atomkernenergie; 22: No. 1, 71-73(Sep 1973). (In German).

From international conference on nuclear physics; Munich, Ger. (27 Aug 1973).

A short review of this conference is given. (GE)

25648 SCATTERING OF HEAVY IONS AT LOW ENERGY IN THE FRAMEWORK OF MOLECULAR ORBITALS. Becker, F.; Joffily, S.; Beccaria, C.; Baron, G. (Centre de Recherches Nucleaires, Strasbourg). Nucl. Phys., A221: No. 3, 475-508(1974).

A generalization of the model of nuclear reactions proposed by Von Oertzen in the framework of molecular orbitals is given. The different equations leading to the cross section are derived and discussed. It turns out that the helicity scheme is the most appropriate one. Some emphasis is given to reactions, including elastic scattering and elastic transfer, for which this approach is well suited. Both the unadiabatic and Coriolis coupling terms which appear in the equations are discussed, and it is shown how these terms are partly canceled if one takes into account one part of the recoil effect. (4 figures) (auth)

25649 EFFECT OF THE Δ(1236) IN THE TWO-NUCLEON PROBLEM AND IN NEUTRON MATTER. Green, A. M.; Haapakoski, P. (Univ. of Helsinki). Nucl. Phys., A221: No. 3, 429-449(1974).

A two-nucleon interaction for the $^{1}S_0$ state is constructed by replacing the σ meson in an OBEP by an inelastic process involving the Δ(1236). The values of the two free parameters introduced to fit $\delta(^{1}S_0)$ are justified by more fundamental approaches. The binding energy of neutron matter is calculated, and it is shown that there is a considerable repulsive contribution not present for an equivalent σ-meson interaction. (18 figures, 2 tables) (auth)

25650 BRUECKNER THEORY INCLUDING MESONIC DEGREES OF FREEDOM. Schuette, D. (Univ., Bonn). Nucl. Phys., A221: No. 3, 450-460(1974).

A many-body theory is developed where the Hilbert space is allowed to contain states of nucleons and mesons. The basis of the theory is the treatment of a field-theoretical Hamiltonian within noncovariant perturbation theory. Only diagrams corresponding to a one-boson exchange (OBE) are taken into account. First, the two-body scattering problem is developed, and this yields a scattering equation corresponding to that of Kadyshevsky. Then the theory is applied to the binding energy problem of nuclear matter in the two hole line approximation with a choice of the single-particle spectrum taken analogously to the Brueckner–Bethe theory. The resulting equations contain meson current corrections, which are physically interpreted. The standard Brueckner theory with static OBE forces is obtained in an adiabatic limit. (5 figures) (auth)

25651 COLLECTIVE ROTATIONS AND MOMENTS OF INERTIA IN THE CLASSICAL MECHANICS OF A DEFORMED OSCILLATOR SHELL MODEL. Morinigo, F. B. (Hahn Meitner Institut fuer Kernforschung, Berlin). Nucl. Phys., A221: No. 3, 608-628(1974).

An alternative to the concepts of the rigid rotor or of the liquid drop as points of departure for the description of collective nuclear motions is presented. The Lagrangian and Hamiltonian of a classical system of A bodies of equal mass are expressed in terms of nonredundant dynamical coordinates defined microscopically so as to correspond to the rotational and vibrational degrees of freedom used customarily in models of collective nuclear motions. Three dynamical coordinates describe the orientation of the principal axes of the tensor of inertia, and three coordinates describe the principal moments of inertia. The potential energy is assumed to depend only on the principal moments of inertia, so that the Lagrangian and Hamiltonian have simple separable forms. The orientation of the principal axes and the intrinsic structure are specified as functionals, rather than point functions, of angular coordinates. The relationships between the equilibrium values of the moments of inertia, the total angular momentum, and other constants of the motion are unambiguous and complete, and these form the basis for a classical theory of the mass parameter of collective rotations for axially symmetric systems. A type of collective motion which is neither a rotation of principal axes nor a shape oscillation appears naturally in this approach. The motion may be intuitively pictured as a coherent flow, and a constant of the motion roughly describable as the vorticity of the flow plays a key role in the description of moments of inertia. The calculation of the energy of axially symmetric systems, if the condition of shape equilibrium is postulated, is found to be formally analogous to the procedures of the variable-moment-of-inertia model. (4 figures) (auth)

25652 EXTRACTION OF SPECTROSCOPIC FACTORS USING R-MATRIX THEORY. Cooper, M. D.; Galati, W.; Hornyak, W. F. (Univ. of Maryland, College Park). Nucl. Phys., A221: No. 3, 528-540(1974).

The relation of the dimensionless reduced width of a state to its spectroscopic strength is discussed, and the spectroscopic factor is calculated as the ratio of the reduced width to that of an optical potential analyzed with the same channel radius and boundary condition number. From a model square-well problem, the reduced width is shown to be sensitive to these parameters. Neutron scattering to the 5.08-MeV state of ^{17}O is analyzed with R-matrix theory, and the value obtained for its spectroscopic factor is 0.80. This value is shown to be moderately independent of the parameters of the optical potential, a fact which greatly simplifies analysis by eliminating the strong dependence upon the location of the pure single-particle state. (4 figures, 2 tables) (auth)

25653 CLASSIFICATION OF SINGLE QUANTUM EXCITATION STATES IN NUCLEI WITH (2s–2d) SHELL. Smirnov, Yu. F.; Shitikova, K. V.; Orlova, N. V. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 5, 553-564(1973). (In Russian).

Tables of the classification of one-quantum excitation states, i.e., states with quantum number $N = N_{min} + 1 = 2A - 19$, were formulated for a series of nuclei with (2s–2d) shells with consideration of the nucleons $A = 17$ to 40 within the translational-invariant shell model. These tables give the classification of states of abnormal parity not only in the translational-invariant shell model but also for the K-harmonic method. (tr-auth)

25654 INTERFERENCE EFFECTS IN ELASTIC SCATTERING OF HEAVY IONS. Da Silveira, R. (Paris Univ., Orsay, France). Compt. Rend., Ser. A, B; 277: No. 12, 317-319(24 Sep 1973). (In French).

A semi-classical analysis is presented on interference effects encountered in the elastic scattering of heavy ions. A method is given for directly extracting from the experimental results an approximate value for the absorption angular momentum. (auth)

25655 SPLITTING OF A DEGENERATE LEVEL UNDER THE ACTION OF A SYMMETRY-BREAKING HAMILTONIAN. Biedenharn, L. C. (Univ., Karlsruhe, Ger.); Gamba, A. Rev. Brasil. Fis.; 2: No. 3, 319-333(Dec 1972).

A quantitative method of computing the size of the splitting of a degenerate level under the action of a symmetry-breaking Hamiltonian is presented. A typical example—the splitting of rotational levels by an octohedral symmetry—is given to illustrate the concepts of the new method. These concepts are rephrased in the language of group theory, and a complete solution is given for specified groups. Generalizations and open problems are discussed. (auth)

25656 ELASTIC SCATTERING OF ELECTRONS ON NUCLEI TAKING INTO CONSIDERATION THE ABNORMAL MAGNETIC MOMENT OF THE ELECTRON. Kerimov, B. K.; Aruri, T. R.; Safin, M. Ya. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 5, 619-621(1973). (In Russian).

The results of the calculation of the elastic scattering cross section of nonpolarized and longitudinally polarized fast electrons on nuclei having electromagnetic multipole moments with consideration of the abnormal magnetic moment of the electron were reported. The formulas obtained for the cross section generalize the results obtained earlier in the case of abnormal magnetic moment of the electron and the helicity correlation between the original and final electrons. (JSR)

25657 TARGET SPIN EFFECTS IN THE SCATTERING OF COMPOSITE PARTICLES. Clark, N. M. (King's Coll., London). J. Phys., A (London); 7: No. 1, L16-L19(1 Jan 1974).

A recent optical model analysis of ^3He elastic scattering data has found evidence of target spin effects. The possible causes of these effects are examined and experiments are suggested which may reveal more information about the target spin effects. (auth)

25658 THREE-BODY APPROACH TO THE EFFECTIVE NUCLEON–NUCLEON INTERACTION. Lovas, I. (Kernforschungsanlage, Juelich, Ger.); Vegh, L. Nucl. Phys.; A220: No. 2, 335-348(1974).

The problem of the effective nucleon-nucleon interaction is formulated in a three-body model. The interaction of two nucleons and a heavy core having internal excitations is described by means of Faddeev-type coupled equations. The elimination of the excited states of the core leads to a set of coupled equations with an effective kernel which incorporates the effect of the eliminated degrees of freedom. An exactly soluble model is constructed and solved. The exact and an approximate solution are compared. The comparison demonstrates the applicability of the model for the investigation of problems connected with the effective nucleon-nucleon interaction. (auth)

25659 PROGRAM CALCULATING THE FORMULAS FOR POLARIZATION EFFECTS IN NUCLEAR REACTIONS. Seiler, F. (Univ., Basel). Comput. Phys. Commun.; 6: No. 5, 229-239(Nov 1973).

In the R-matrix theory of nuclear reactions, properly normalized observables can be expanded in terms of rotation matrices or Legendre functions. The corresponding expansion coefficients are then bilinear functions of the reaction matrix elements in the (l,s,J) coupling scheme. The numerical factor for each bilinear combination of matrix elements in a given coefficient is a function involving Clebsch–Gordan, Racah, and X coefficients. By obtaining numerical values for the angular momentum functions and taking into account all relevant symmetries, the program FATSO computes the explicit formulas for any observable quantity for a given set of (l,s,J)-matrix elements. A set of 40 matrix elements can be accommodated, with up to 20 expansion coefficients. Approximate running time for cross sections involving vector- and tensor-polarized deuteron beams for a set of 20 matrix elements is 2 minutes. The program, in FORTRAN IV for the UNIVAC 1108 and the operating system EXEC 8, requires 44030 36-bit words of computer memory. (RWR)

25660 ZERO-RANGE DENSITY DEPENDENCE IN EFFECTIVE INTERACTION. Zofka, J. (Inst. of Nuclear Physics, Prague). Czech. J. Phys.; 24: No. 1, 32-47(1974).

A class of approximate interactions ZRA, having contact density dependence and microscopically derived density independent part, is constructed. Such an approximation retains all physical virtues of non-contact density dependent interactions and simplifies numerical calculations considerably. ZRA is tested and compared with similar interactions in nuclear matter and in s-d shell. The spurious "self-screening" rearrangement term S_α and a shape transition in ^{32}S are studied. (auth)

25661 CONNECTION BETWEEN HYPERSPHERICAL HARMONICS AND SIMPLE SHELL MODEL. Sotona, M.; Zofka, J.

(Inst. of Nuclear Physics, Rez, Czech.). Lett. Nuovo Cim.; 9: No. 7, 261-265(16 Feb 1974).

A comparison is made of the binding energies, r.m.s. radii, and Coulomb energies for ^{16}O calculated by means of the hyperspherical-harmonics method and by means of the simple independent-particle model. It is shown that for such calculations both models are competitive and thus the much simpler independent-particle model should be preferred. (LBS)

25662 MICROSCOPIC CALCULATION OF LIQUID AND SOLID NEUTRON STAR MATTER. Chakravarty, S.; Miller, M. D.; Woo, C. W. (Northwestern Univ., Evanston, IL). Nucl. Phys.; A220: No. 2, 233-240(1974).

As the first step to a microscopic determination of the solidification density of neutron star matter, variational calculations are performed for both liquid and solid phases using a very simple model potential. The potential, containing only the repulsive part of the Reid $^1S_0$ interaction, together with Boltzmann statistics defines a "homework problem" which several groups involved in solidification calculations have agreed to solve. The results were to be compared for the purpose of checking calculational techniques. For the solid energy good agreement with Canuto and Chitre was found. Both the liquid and solid energies are much lower than those of Pandharipande. It is shown that for this oversimplified model, neutron star matter will remain solid down to ordinary nuclear matter density. (auth)

25663 ADIABATIC AND NON-ADIABATIC CRANKING MODELS FOR THE SOLUTION OF THE LARGE AMPLITUDE TIME-DEPENDENT HARTREE–FOCK EQUATION AND THE CALCULATION OF NUCLEAR ENERGY SURFACES. Rowe, D. J. (Universidade de Sao Paulo, Brazil); Bassermann, R. Nucl. Phys.; A220: No. 2, 404-428(1974).

An analysis is made of the device of forced vibrations to reduce the difficult large amplitude TDHF (time-dependent Hartree–Fock) problem to a simpler static problem. It is shown that cranking is a perfectly valid technique if the cranking field is defined by the criterion that the constrained static wave function be identical at a given instant of time to the freely oscillating TDHF wave function. On the basis of this criterion an exact general expression is derived for the cranking field and adiabatic and nonadiabatic cranking models are proposed as practical means of solving the large amplitude TDHF equations and calculating energy surfaces for fission and heavy ion reactions. The nonadiabatic model, which is favored, corresponds to cranking the nucleus to move always in the direction of a local decoupled "normal mode" calculated from its unconstrained time-dependent equations of motion. The familiar Belyaev cranking model and the Baranger–Kumar model are discussed in the context of the new formalism. (auth)

25664 DIFFERENT METHOD FOR SOLVING THE HARTREE–FOCK EQUATIONS. Kelemen, A. (Univ., Frankfurt am Main). Nucl. Phys.; A220: No. 2, 391-394(1974).

A method is presented which guarantees the convergence of the solution of HF equations. (auth)

25665 MICROSCOPIC MODEL OF THE ELASTIC SCATTERING OF MEDIUM ENERGY ALPHA PARTICLES. Budzanowski, A.; Dudek, A.; Grotowski, K.; Majka, Z.; Strzalkowski, A. (Inst. of Nuclear Physics, Krakow). Particles Nucl.; 6: No. 4, 97-112(Oct 1973).

A microscopic description of the elastic scattering of medium energy alpha-particles is given in terms of an optical potential calculated from an effective nucleon-nucleon interaction and the nuclear matter distributions in both colliding nuclei. The model and its properties are studied for $45 \leq A \leq 208$ with the effective nucleon-nucleon interaction of Slanina-McManus form. Double folding procedure applied results in the form factor of the real potential being different from the Saxon-Woods one. Good agreement with experimental data is obtained and a real potential depth of about 200 MeV predicted. (auth)

25666 THEORY OF DIRECT REACTIONS LEADING TO RESONANT STATES. Dolinskii, E. I.; Mukhamedzhanov, A. M. (Moscow State Univ.). Phys. Lett.; 48B: No. 2, 95-98(21 Jan 1974).

The theory of direct reactions leading to isolated resonant states is formulated in the form which is suitable for any reaction mechanism and for any decay modes of the resonant state. (auth)

25667 SEMI-CLASSICAL THEORY OF NUCLEAR REACTIONS. Rook, J. R. (Univ. , Munich). Phys. Lett.; 48B: No. 2, 148-150(21 Jan 1974).

Semi-classical theory has previously been derived with assumptions contrary to the usual experimental situation, in particular that the wave packets describing the projectile are small. It is shown that the same answers are obtained with large wave packets. (auth)

25668 GAMOV–TELLER ISOBARIC 1^+ RESONANCE. Gaponov, Yu. V.; Lyutostanskii, Yu. S. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 19: No. 1, 62-74(Jan 1974). (In Russian).

The theory of finite Fermi systems is used to calculate the β-decay positions and matrix elements for the Gamov–Teller resonance in spherical nuclei from As to La. The quasiclassical solution is as well found for three of the most collective 1^+ states. It is shown that the energy and matrix element of β-decay of the Gamov–Teller resonance in heavy nuclei approach the analog ones with increasing $N-Z$. Therefore it is concluded that the analog state having the isospin T_0 and the Gamov–Teller resonance with the isospin T_0-1 are of the same Wigner supermultiplet $(T_0, 0, 0)$. The supermultiplet symmetry must be restored with increasing A and $N-Z$. (auth)

25669 VELOCITY-DEPENDENT EFFECTIVE POTENTIAL OF THE S-WAVE INTERACTION AND THE STRUCTURE OF FINITE NUCLEI. Dzhibuti, R. I.; Sallam, Kh. M. (Inst. of Physics, Tbilisi, USSR). Yadern. Fiz.; 19: No. 1, 75-82(Jan 1974). (In Russian).

The scheme is presented to calculate the structure of finite nuclei based on the effective two-nucleon potential of the s-wave interaction. It is shown that the velocity-dependent effective potential of the s-wave interaction with one free parameter gives good results both for the binding energy and for radii of a large group of nuclei from ^{4}He through ^{208}Pb. (auth)

25670 OPERATOR MATRICES FOR THE COLLECTIVE MODEL OF NUCLEUS AND THE PHYSICAL BASIS OF THE GROUP O(5). Gai, E. V. (Physical Energy Inst., Moscow). Yadern. Fiz.; 19: No. 1, 83-92(Jan 1974). (In Russian).

A method to construct the physical basis function for the group O(5) and to calculate the matrix elements of the most important operators of the collective model of nucleus at arbitrary λ, L is presented. In the general case, the calculation of the matrix elements is reduced to a simple sum and to application of a recursion relation, for some particular cases the method provides analytical expressions for the basis functions and for the matrix elements. A set of coupled equations is obtained for the eigenfunctions and eigenvalues of the additional quantum number Ω operator. (auth)

25671 SPONTANEOUS PRODUCTION OF POSITRONS AT COLLISIONS OF HEAVY NUCLEI (PRODUCTION CROSS SECTION AND THE ENERGY SPECTRUM OF e^+). Popov, V. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 19: No. 1, 155-168(Jan 1974). (In Russian).

Analytical solution of the two-center Coulomb problem for the Dirac equation is obtained in the approximation $(Z_1 + Z_2 - Z_c)/Z_c \ll 1$. Using the solution, the total cross section σ of the positron production in quasistatic field of the colliding nuclei, the cross section $d\sigma/d\Omega$ corresponding to the scattering of the nucleus under a fixed angle θ, and energy spectrum of the produced positrons are calculated. Dependence of these quantities on the incident nucleus energy E is considered, that enables one to suggest the energy region optimal for the experiment. The similar problem of the e^+e^--pair production from vacuum in a variable electric field E(t) is discussed briefly. (auth)

25672 SHELL CLOSURES IN SPHERICAL NUCLEI WITH GREAT NEUTRON EXCESS. Tondeur, F. (Univ., Brussels). J. Phys. (Paris); 34: No. 10, 761-769(Oct 1973). (In French).

The single-particle spectra of spherical neutron-rich nuclei are studied. A Saxon–Wood potential is used. The parameters of the potential are first extrapolated from the expressions which are generally used for stable nuclei. Other expressions are also calculated on the basis of Brueckner's statistical model. (FR)

25673 DIRECT INTERPRETATION OF NUCLEAR PROPERTIES IN TERMS OF COLLECTIVE MODEL PARAMETERS. Cline, D.; Flaum, C. (Univ. of Rochester, NY). Kakuriken Kenkyu Hokoku; 5: 61-82(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendei, Japan (12 Sep 1972). See CONF-720907-.

The interpretation of experimental electromagnetic matrix elements directly in terms of collective degrees of freedom for any state without recourse to a model is investigated. The understanding and discussion of many-body systems having shapes deviating from spherical symmetry is much facilitated by making a transformation into the body-fixed system. The present method uses rotationally invariant products of multipole operators to relate properties in the principal axis and laboratory frames. The method is applicable to any spherical tensor operator, but is most useful for the E2 operator. The method was used to analyze experimental data over a wide range of nuclei. Centroids and vibrational amplitudes for the intrinsic quadrupole moments and moment asymmetries are shown for the ground states of Ba, Ce, Nd, Sm, Ru, Pd, and Cd, and the moment asymmetries for W, Os, and Pt. One use for the sum rule method is the interpretation of E4 transition strengths in terms of deformation parameters β_4. (13 figures) (RWR)

25674 MODEL INDEPENDENT EVALUATION OF ELASTIC AND INELASTIC ELECTRON SCATTERING DATA. Andresen, H. G. (Inst. fuer Kernphysik, Mainz). Kakuriken Kenkyu Hokoku; 5: 103-113(1972).

From international conference on nuclear structure studies using electron scattering and photoreaction; Sendei, Japan (12 Sep 1972). See CONF-720907-.

The general features of a model-independent evaluation method for elastic scattering on $I = 0$ nuclei are summarized in order to investigate whether these evaluation principles may be extended to inelastic and elastic scattering for $I \neq 0$ nuclei. The only difference in inelastic scattering as compared with elastic is that the transition distributions for inelastic scattering are no longer restricted to positive values. For a model-independent evaluation of electric transitions it is necessary to incorporate the continuity equation explicitly into the electric amplitudes. In contrast to the situation in plane-wave approximation, distorted waves will cause the interference of the electric amplitudes. A model-independent evaluation of electric transitions will be cumbersome and require large amounts of computational effort; without a fast DWBA code a model-independent evaluation of inelastic scattering data will be hopeless. (1 figure) (RWR)

25675 ANGULAR MOMENTUM COUPLING IN HEAVY-ION TRANSFER REACTIONS. Santos, F. D. (Laboratorio de Fisica Engenharia Nucleares, Sacavem, Portugal). Phys. Lett.; 48B: No. 3, 193-195(4 Feb 1974).

A general expansion of the distorted-wave transition amplitude for heavy-ion transfer reactions into terms with definite recoil orbital angular momentum transfer is given and discussed. It is shown that recoil effects tend to be enhanced when the surface localization of the reaction is not favored by kinematical conditions. (auth)

25676 HARTREE–FOCK LANE POTENTIAL. Nemeth, J. (Nuclear Physics Lab., Oxford); Fai, G. Phys. Lett.; 48B: No. 3, 191-192(4 Feb 1974).

The charge-exchange potential was determined microscopically by starting from two-body forces and totally antisymmetrized wave functions. The results for proton scattering by ^{48}Ca are plotted. (auth)

25677 EFFECT OF NUCLEON CORRELATIONS ON PION CONDENSATION IN NEUTRON STARS. Rajaraman, R. (Inst. for Advanced Study, Princeton, NJ). Phys. Lett.; 48B: No. 3, 179-182(4 Feb 1974).

It is pointed out that nucleon–nucleon correlations play an important role in the pion condensation problem. Their effect is estimated by a simple analytical method. It is seen that they inhibit condensation by reducing the attraction a pion might otherwise feel in nuclear matter. Further, the effect of correlations increases with nucleon density, ρ, offsetting the corresponding increase in the attraction felt by pions in free neutron matter. (auth)

25678 SHELL-MODEL APPROACH TO THE NUCLEON ELASTIC SCATTERING BY NUCLEI. Urin, M. G. (Moscow Physical–Engineering Inst.); Zaretski, D. F. Phys. Lett.; 48B: No. 3, 176-178(4 Feb 1974).

The averaged scattering matrix is parametrized on the basis of the shell-model approach to nuclear reactions. The method is applied to the calculation of s-neutron strength functions. It is shown that, in contrast to the optical-model predictions, the isotopic dependence of the strength function in its minimum ($A \sim 100-140$) is mainly determined by the 3s-state spectroscopic factor. (auth)

25679 CAN PION SCATTERING YIELD USEFUL NUCLEAR STRUCTURE INFORMATION? Wilkin, C. (CERN, Geneva). Nucl. Phys.; A220: No. 3, 621-627(1974).

It is pointed out that for excitations involving magnetic transitions, pion scattering from nuclei should in principle allow a separation of the orbital and spin contributions. This is not possible in electron scattering. (auth)

25680 SUM RULE APPROACH FOR NUCLEAR VIBRATIONS AND EFFECTS OF CORE POLARIZATION. Suzuki, T. (Inst. of Physical and Chemical Research, Wako, Japan). Nucl. Phys.; A220: No. 3, 569-579(1974).

The eigenfrequencies of the isovector nuclear vibrations, whose excitation strengths exhaust the classical energy weighted sum rule value, are estimated by making use of various sum rules. The less model dependent forms of the variations of isovector nuclear density and average field under the vibrations are also obtained in the sum rule approach, and used to estimate the isovector effective charges and their momentum transfer dependence, isospin impurity and the correction to the Coulomb energy difference. (auth)

25681 CONSEQUENCES FOR NUCLEAR PHYSICS OF A $NN\gamma$ AND A $N^*N\gamma$ TIME REVERSAL VIOLATING VERTEX. Bezerra Coutinho, F. A. (Univ. of Sussex, Eng.). Nucl. Phys.; A220: No. 3, 520-532(1974).

The effects in low energy nuclear physics of a possible time reversal invariance (TRI) violation in the electromagnetic interaction are studied. It is shown that this effect appears as a two body short range TRI violating transition operator or as a two and three body TRI violating potential. Two cases are studied. Firstly a TRI violating $NN\gamma$ vertex is considered and found to have very little effect. Secondly the TRI violation is assumed to occur in the $NN^*\gamma$ vertex and it is shown that if the violation is "maximal" the contribution to the imaginary part of the "mixing ratio" δ is Im $\delta \approx |\delta| \times 10^{-3}$. This should be measurable. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

25682 PLASMA PHYSICS INDEX. Volume 9, No. 1, 1974. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 147p.

The bibliography contains 453 references complete with keyword descriptors. Subject and author indexes are included. (MOW)

25683 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 8, No. 1, 1974. Bibliography, Author Index, Subject Index, Appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 45p.

Confinement and Heating

Refer also to abstracts 25736, 25755, 25784, 25796, and 25807.

25684 (AD-763738) OPTIMAL CONTROL OF PARABOLIC SYSTEMS WITH BOUNDARY CONDITIONS INVOLVING TIME-DELAYS. Wang, P. K. C. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Jun 1973. 35p. (UCLA-ENG-7346; AFOSR-TR-73-1152). NTIS $3.00.

Various optimal control problems with quadratic cost functionals for parabolic systems with Neumann boundary conditions involving time-delays are considered. Necessary and sufficient conditions for which the optimal controls must satisfy are derived. Estimates and a sufficient condition for the boundedness of solutions are obtained for systems with more complex boundary conditions involving time-delays are discussed briefly. (auth)

25685 (AD-763777) TURBULENT HEATING OF PLASMAS BY STREAMING INSTABILITIES. Drummond, W. E.; Thompson, J. R.; Wong, H. V. (Austin Research Associates, Inc., Tex. (USA)). Jun 1973. Contract F44620-72-C-0071. 42p. (ARA-106, AFOSR-TR-73-1147). NTIS $4.25.

During the past year of work on this contract, substantial progress has been made toward the research goal of understanding the development and nature of turbulence generated from a source of free streaming energy within a collisionless plasma. A powerful beam of energetic electrons was externally generated and injected into a target plasma. The calculations indicate the possibility of efficiently coupling the large beam energy into a magnetized target plasma during the very brief transit time of the beam, provided that the beam quality is sufficiently high, and that the beam energy and density are adjusted to optimize the primary beam-plasma turbulent interaction. In addition an analyses was made which revealed conditions for the equilibria and stability of unneutralized electron beams propagating along a magnetic guide field. (auth)

25686 (AD-766831-2) STUDY OF BEHAVIOR AND PROPERTIES OF A PLASMA UNDER CONDITIONS OF RAPID HEATING. Final Report, 1 September 1963–August 31, 1969. Kerr, D. E. (Johns Hopkins Univ., Baltimore, Md. (USA). Dept. of Physics). May 1973. 10p. NTIS $3.00.

Investigations of the properties of a small linear electromagnetic shock tube reveal the following: At pressures of about 1 torr in helium there can be very large deviations from local thermal equilibrium; in argon the reverse can be true, and good measurements of conventional plasma properties are possible; precursor effects in helium are very strong, and occur because of a very specific sequence of ultraviolet radiations from the discharge chamber, rather than from potential waves or particles. Preliminary studies of energy transfer in a plasma typical of pulsed argon-ion lasers indicate new relationships of trapping of resonance radiation and wall effects to laser behavior. (auth)

25687 (AD-767220-7-GA) STUDY OF ELECTRODELESS ARC DISCHARGE USING ARGON, NITROGEN, AND AIR. Final Report, January 1972–March 1973. Keefer, D. R. (Florida Univ., Gainesville (USA)). Sep 1973. 47p. (AEDC-TR-73-143). NTIS $3.00.

A study of the bluff-body stabilized electrodless arc was undertaken to extend the operation to greater mass flow rates and power input. A small arc chamber, operating at a frequency of 3.5 MHz, was operated with mass flows up to 1.026 gm/sec of argon at atmospheric pressure with a power input of 6.79 kW. Under these conditions a plasma bulk temperature of 2305°K was obtained with a heating efficiency of 18%. It was found that heating efficiency increased with chamber pressure, but bulk temperature depends primarily upon the power input. A larger arc chamber was designed for a nominal power input of 200 kW at a frequency of 377 MHz. This chamber was operated at mass flow rates up to 2.4 gm/sec of argon at a pressure of two atmospheres. A plasma bulk temperature of 5856°K was obtained at a power input of 76 kW. Attempted operation using air as a working fluid was unsuccessful at pressures in excess of ¾ atmosphere due to inefficient coupling to the arc plasma. (auth)

25688 (AD-768062-2-GA) FUNDAMENTAL STUDIES ON TURBULENT HEATING OF A FUSION PLASMA. Annual Summary Report, 1 July 1972–30 June 1973. Wharton, C. B. (Cornell Univ., Ithaca, N. Y. (USA)). 30 Jun 1973. 22p. NTIS $2.75.

During the past year the investigation has continued of the scaling laws of turbulent heating and on optimizing the experiment as a pulsed plasma heating device. Three main conclusions were reached from these investigations: The plasma resistivity is anomalously large during turbulent heating, approaching the Buneman value normally associated with the electron 2-stream instability, yet the observed turbulent spectrum is more appropriate for ion acoustic waves; the ion energy distribution is non-Maxwellian, but nearly isotropic. The ions have a small drift in one direction, and a high energy tail in the opposite (electron drift) direction; the turbulent heating often limits itself before the peak of the current is reached. (GRA)

25689 (AD-768341-0-GA) NONLINEAR ABSORPTION AND HEATING OF DENSE PLASMAS. Technical Report, June–August 1973. Roderick, N. F. (Air Force Academy, Colo. (USA)). Sep 1973. 49p. (DFAN-TR-73-7). NTIS $3.00.

Absorption of laser radiation by dense plasmas was studied using the model of Dubois, Goldman, and McKinnis for saturation of the parametric decay instability. The basic model contains both linear and nonlinear absorption mechanisms. The nonlinear mechanism includes spectrum broadening. Landau damping, and mode coupling. Modifications have been made to investigate various density profiles and to include the increase in threshold intensity due to the presence of the nonuniform plasma. Physical parameters investigated are those characterizing an exploding aluminum wire plasma and the pinch region of a dense plasma focus both illuminated by a high intensity CO_2 laser. Results indicate the previously noted increases in absorption due to the inclusion of the nonlinear saturation mechanism. The previously obtained increases in absorption with increasing density scale height and decreasing temperatures are also recovered. The former indicates end on illumination of the pinch region as the most favorable for heating. The general density results also show the absorption to be a strong function of the shape of the density profile. (auth)

25690 (FRNC-TH-432) HEATING OF A PLASMA CONFINED IN A TOKAMAK TYPE MAGNETIC CONFIGURATION BY THE INJECTION OF FAST NEUTRAL PARTICLES. Khelladi, M. (Paris-6 Univ., 75 (France)). 1972. 130p. (In French). Dep. NTIS (U. S. Sales Only) $8.50.

Thesis.

A numerical model was developed for the injection heating of fast neutral particles of a plasma confined in a Tokamak configuration. The Tokamak currently being constructed at Fontenay-aux-Roses (TFR) is considered. An extrapolation towards a machine enabling the ignition temperature to be reached is proposed and it is shown that this experiment can be carried out using currently available technology. The model takes into account particle transport phenomena and the experimentally observed heat (some hypotheses having been put forward on ionic thermal conduction at temperatures not yet achieved). The treatment of fast heating of ions is carried out using the assumption that these ions are captured on a magnetic surface where they remain during the entire period during which they give up their energy. The model also takes into account interactions between the plasma and the walls of the enclosure, degassing phenomena being of considerable importance. As an example, it was demonstrated that in the TFR machine, the injection of an 11 A current of neutral particles at 25 keV in the perpendicular mode during a period of 200 ms can, under particular ion heat transport conditions (banana zone), increase the ion temperature of the plasma by 1.5 keV for an initial density of 3.54×10^{13} cm^{-3} (recycling effects being taken into consideration). (FR)

25691 (JPRS-61306) PROBLEMS OF PLASMA THEORY. Leontovich, M. A. (ed.). Translated From Vop. Teor. Plazmy; No. 7, 205-245; 271-273(1973). 51p. NTIS.

Articles are presented on the neoclassical theory of diffusion and on the kinetic theory of plasma equilibrium in axisymmetric systems. (auth)

25692 (ORO-4211-11) PLASMA HEATING AND CONFINEMENT STUDIES. (Tennessee Univ., Knoxville (USA)). 1974. 78p. Dep. NTIS $6.00.

The creation of a dense, hot-electron plasma is discussed. Some related experiments are described. The following papers are included in the report: (1) evolution of current-driven instabilities and anomalous properties including electron viscosity in inhomogeneous plasma, (2) properties of waves defined by the dispersion relation $D(k,\omega) = 1 - (\omega_j^2/\omega^2) + (k_j^2/k^2) = 0$, and (3) theoretical prediction of the observed plasma heating in the compression experiment of ITO's group at Osaka University. (MOW)

25693 (SLA-73-5967) ELECTRON BEAM INDUCED FUSION. Yonas, G. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 33p. (CONF-740201-2). Dep. NTIS $3.75.

From topical conference on energy; Chicago, Illinois, USA (4 Feb 1974).

The use of tightly focused relativistic electron beams for heating and compression of a plasma for controlled fusion is described. Recent progress as well as areas for further study, particularly oriented toward the creation of reactor concepts is outlined. (MOW)

25694 (UCID-16459) SOME RECENT COMPUTATIONAL RESULTS ON MIRROR CONFINEMENT. Rensink, M. E.; Killeen, J.; Mirin, A. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Mar 1974. Contract W-7405-eng-48. 18p. Dep. NTIS $3.00.

The two-dimensional Fokker–Planck code is used to study mirror confinement as a function of mirror ratio and neutral beam injection angle. (auth)

25695 CO_2 LASER BEAM REFRACTION IN A LINEAR DISCHARGE PLASMA. Molen, G.M.; Kristiansen, M.; Hagler, M.O. (Plasma Laboratory, Department of Electrical Engineering, Texas Tech University, Lubbock, Texas 79409). Appl. Phys. Lett. 23: No. 11, 601-603 (1 Dec 1973).

Beam guiding and focusing have been observed for CO_2 laser propagation in a high-density low-temperature annular plasma. A TEA laser was fired along the axis of a cylindrical plasma column of densities in the 10^{16}–10^{17}-cm^{-3} range. Several radial density profiles were investigated. Beam guiding and focusing were observed when the density had a minimum on the axis. A density maximum on-axis refracted the beam toward the tube walls, and intense "hot spots" resulting from apparent filamentation inside the plasma were recorded. (auth)

25696 INTERACTION OF A RELATIVISTIC ELECTRON BEAM WITH A TURBULENT PLASMA. Korn, P.; Sandel, F.; Wharton, C.B. (Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14850). J. Appl. Phys. 44: No. 11, 4946-4949 (Nov 1973).

The interaction of a relativistic electron beam ($\nu/\gamma \sim 2$) with the turbulent phase of a Z discharge is examined. An enchancement in heating is observed when the electron current due to the Z discharge is in the opposite direction to the beam current and the plasma is highly turbulent. The ion energy distribution is examined for turbulent heating, beam heating, and combined beam and turbulent heating. (auth)

25697 STAGING OF THETA PINCHES USING LASER-HEAT ADDITION AND MAGNETIC COMPRESSION. Hoffman, A.L. (Mathematical Sciences Northwest, Inc., 4545 15th Avenue, N. E., Seattle, Washington 98105); Vlases, G.C. Appl. Phys. Lett. 23: No. 12, 690-692 (15 Dec 1973).

The thermodynamics of using laser heating in conjunction with magnetic compression in θ-pinch plasmas is discussed. It is shown that the minimum laser energy required to achieve a given plasma filling factor Λ (ratio of plasma to plasma tube area), is $E_{laser} = \Lambda^{2/3}E_{plasma}$ and that any filling factor up to $\Lambda = 1$ can be achieved. The proposed schemes have important implications for either increasing the performance of standard θ pinches or for replacing the single-turn θ-pinch coil by a multiturn solenoid. (auth)

25698 ELECTRON BEAM AND DENSE PLASMA FOCUS INTERACTION HEATING EXPERIMENTS. Mather, J.W.; Carpenter, J.P.; Freiwald, D.A.; Ware, K.D.; Williams, A.H. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). J. Appl. Phys. 44: No. 11, 4913-4919 (Nov 1973).

Several attempts to transiently heat a dense plasma focus discharge using intense electron beams at voltages of 280 to 300 keV and 3.6 MeV are discussed. The results, although requiring further confirmation, suggest a positive interaction and indicate that low ν/γ beams are required for injection into the plasma focus column. (auth)

25699 STRONG AXIAL LASER HEATING OF A THETA-PINCH PLASMA. Hoffman, A.L. (Mathematical Sciences Northwest, Inc., 4545 15th Avenue, N. E., Seattle, Washington 98105). Appl. Phys. Lett. 23: No. 12, 693-695 (15 Dec 1973).

Holographic interferograms are shown of θ-pinch plasmas heated axially by 35 J of 10.6-μm radiation. One hundred percent conversion of laser to plasma thermal energy is indicated by the resultant plasma expansion and inferred temperature increase from 10 to 65 eV. The heated plasma column in 10 cm long by 6 mm in diameter and at an electron density of about 5×10^{17} cm^{-3}. The laser heating process is seen to produce a self-trapping density minimum on axis in contrast to the density maximum encountered in normal unheated θ pinches. This has significant implications for the high-density laser-heated long-solenoid approach to fusion. (auth)

25700 EQUILIBRIUM OF A PLASMA CONFINED BY A MAGNETIC FIELD BETWEEN TWO PARALLEL PLATES. Namiot, V.A. Sov. Phys.-Tech. Phys. 18: No. 4, 537-538 (Oct 1973).

It is shown that if the magnetic field does not penetrate the plasma and the ratio of the thickness of the plasma column to the distance between the walls along the minor axis of the ellipse (for a chamber with a highly eccentric cross section) is greater than some critical value, then the eccentricity of the region occupied by the plasma is determined by the eccentricity of the chamber. (AIP)

25701 HEATING OF A DENSE PLASMA BY A POWERFUL ELECTRON BEAM. Bredikhin, M.Y.; Maslov, A.I.; Skibenko, E.I.; Yuferov, V.B. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.-Tech. Phys. 18: No. 3, 328-332 (Sept 1973).

The variations of electron temperature, mean ion energy, and amplitude of induced microwave oscillations in the plasma are determined as functions of time and of the beam-plasma parameters in the magnetic field range 10-35 kOe at the center of the trap. Values of $T_e \simeq 3$ to 4 keV are attained for an electron beam power of 4 MW. The temperature growth is proportional to the energy deposition in the plasma. The plasma heating process is accompanied by intensive microwave emission, the level of which exceeds thermal radiation by several orders of magnitude. From particle measurements the mean energy of charge-exchange neutrals emerging from the plasma perpendicular to the magnetic field is calculated. This value appears to be about 100-200 eV, and in certain cases, rises to 400 eV. From comparison of theory with experiment, it is concluded that the fundamental mechanisms leading to plasma heating are cyclotron and hybrid resonances. The energy content of the plasma is about $1.5 \cdot 10^{18}$ eV/cm^3, and is due primarily to the electron component. (auth)

25702 MAXIMUM EQUILIBRIUM PRESSURE OF A PLASMA IN A SPATIAL SYSTEM WITH HELICAL SYMMETRY. Yurchenko, E.I. Sov. Phys.-Tech. Phys. 18: No. 3, 312-314 (Sept 1973).

The maximum allowed equilibrium pressure depends on the form of the separatrix of the family of magnetic surfaces obtained from the equation of the lines of force. The optimum variation in the form of the separatrix enables one to increase the allowed equilibrium pressure by approximately a factor of 2 as compared with the pressure for a circular separatrix. (AIP)

25703 COULOMB LOSS OF ELECTRONS FROM A MIRROR DEVICE WITH A POSITIVE PLASMA POTENTIAL. Yushmanov, E.E. Sov. Phys.-Tech. Phys. 18: No. 3, 315-317 (Sept 1973).

A nonrigorous examination of Coulomb diffusion in velocity space is used to derive an analytic equation that describes the electron loss from a trap in a state of collisional equilbibrium in the limiting case of a high potential barrier. The dependence on R and ϕ is different from that used in a number of other papers. An expression is also given for the energy spectrum of the electrons leaving the trap. (auth)

25704 EFFECT OF LONGITUDINAL THERMAL CONDUCTIVITY ON OHMIC HEATING IN TUMAN-1. Kaganskii, M.G.; Kalmykov, S.G.; Shakhovets, K.G. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.-Tech. Phys. 18: No. 2, 197-201 (Aug 1973).

Local introduction of energy into a toroidal device with a longitudinal magnetic field which is inhomogeneous in the longitudinal direction leads to a number of distinctive effects in ohmic heating of the plasma. A significant longitudinal temperature gradient is observed at a plasma density of 10^{14}–10^{15} cm^{-3} and an electron temperature of 5–30 eV. An analysis of the energy balance is performed, including the longitudinal electronic conductivity. The dependence of electron temperature on discharge parameters is obtained. A comparison of calculations with measurements of the temperature as determined from conductivity shows that if the directed electron velocity does not exceed the ion-acoustic velocity, the thermal conductivity is close to the classical value as determined from binary Coulomb collisions. (auth)

25705 ELECTRON INJECTION THROUGH THE DIVERTER IN A HELIOTRON. Zykov, V.G.; Karpukhin, V.I.; Lonin, Y.F.; Rudnev, N.I.; Tolok, V.T. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.-Tech. Phys. 18: No. 2, 188-191 (Aug 1973).

Experiments are described on the injection of electron beams through the magnetic slots of a diverter into the main chamber of a heliotron device. The point electron beam is converged by the diverter magnetic field into a (hollow) cylinder in the main chamber, the diameter of the cylinder being approximately equal to the diameter of the diverter magnetic surface. The cylinder is found to consist of two coaxial cylinders. (auth)

25706 EQUILIBRIUM OF A TOROIDAL PLASMA WITH NONCIRCULAR CROSS SECTION. Zakharov, L.E.; Shafranov, V.D. (I. V. Kurchatov Institute of Atomic Energy, Moscow). Sov. Phys.–Tech. Phys. 18: No. 2, 151-156 (Aug 1973).

The possibility of determining the cross-sectional form of a Tokamak plasma from measurements of the magnetic field outside the plasma is indicated. Two kinds of integral relation are obtained. The first, based on the equilibrium equations, gives an expression for the multipole moments of the generalized pressure in terms of a surface integral of quadratic combinations of the measured magnetic field. The second, based on the magnetic field equations, gives an expression for the analog of the multipole densities of the longitudinal current density in terms of a surface integral of linear combinations of the magnetic field measured outside the plasma. (auth)

25707 CO_2 LASER–DRIVEN ABSORPTION WAVES IN UNDERDENSE HYDROGEN. Burnett, N.H.; Offenberger, A.A. (Department of Electrical Engineering, University of Alberta, Edmonton, Canada). J. Appl. Phys. 45: No. 2, 623-625 (Feb 1974).

A 600–MW CO_2 laser oscillator has been used to induce breakdown in hydrogen with filling pressures in the range 10–20 Torr. The breakdown region is observed to undergo a transition from an optically thin symmetric expansion at laser fluxes in excess of $\sim 10^8$ W/cm^2 to an optically thick undirectional expansion at laser intensities below this. (auth)

25708 INJECTION OF NEUTRALIZED BEAM CONSISTING OF POSITIVE AND NEGATIVE IONS INTO MAGNETIC TRAP FILLED WITH PLASMA. Gabovich, M. D.; Naida, A. P.; Pashitskii, E. A. (Inst. of Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 10, 1748-1749(Oct 1973). (In Russian).

The use of interacting beams of positive and negative ions of equal concentration was proposed for injection of fast charged particles into a magnetic trap. The conditions for the propagation of such a two-component beam across a magnetic field were examined and the possibility of the capture of the ions was discussed. (tr-auth)

25709 OCTOPOLE SHELL-LESS TOKAMAK WITH A STRONG VERTICAL MAGNETIC FIELD. Sakurai, K.; Tanaka, Y.; Okuda, T. (Nagoya Univ., Japan). Phys. Lett., 46A: No. 5, 331-332(14 Jan 1974).

Equilibria of the octopole shell-less Tokamak are calculated as a function of the plasma pressure. Stable equilibrium in the horizontal direction is obtained with a strong vertical magnetic field. (auth)

25710 PARAMETRIC EXCITATION OF LONGITUDINAL WAVES IN FINITE PLASMAS BY HIGH-FREQUENCY ELECTRIC FIELDS. Gradov, O. M. Zh. Prikl. Mekh. Tekh. Fiz.; No. 1, 159-161(1974). (In Russian).

The parametric excitation of surface oscillations in finite plasma by modulated high-frequency fields is examined. It is established that in the area of localization of the surface waves, adjacent to the plasma boundary, parametric instabilities develop in the case when the frequency of the amplitude modulation is close to the doubled frequency of the surface mode. In other respects the plasma volume is stable. This makes it possible to use modulated high-frequency fields for the heating of the plasma surface. (tr-auth)

25711 LASER-BEAM HEATING OF EROSION LOW-TEMPERATURE PLASMA IN PROCESSES OF ITS GASDYNAMIC MOTION. Goncharov, V. K.; Min'ko, L. Ya.; Tyunina, E. S.; Chumakov, A. N. Zh. Prikl. Mekh. Tekh. Fiz.; No. 1, 13-18(1974). (In Russian).

Investigations were made of the gasdynamic and optical properties of erosion plasma jets under conditions of passage of laser radiation through them and without the laser radiation. It is shown that in processes of plasma formation under the effect of laser radiation of reduced intensity ($q \sim 10^7$ W/cm^2) on the absorbing material, the heating of the decay products by the interacting laser radiation plays a significant role. The temperature distribution along the plasma jet formed during laser interaction is obtained. A temperature maximum on the outlet from the tube caused by heating of the erosion laser plasma by incident laser radiation during its one-dimension gasdynamic movement and indicating a screening of the surface from the laser radiation is detected. It is established that the gasdynamic structure of the plasma jet and the porosity of the plasma jet corresponding to the regular pulse of the laser radiation affects the screening effect. (tr-auth)

25712 PLASMA LOSSES THROUGH AN ADIABATIC CUSP. Kaye, A. S. (Queen's Univ., Belfast). J. Plasma Phys.; 11: 77-91(Feb 1974).

Previous calculations of $\lambda = 1$ cusp losses were extended to the case where there exists a third "adiabatic" invariant of the particle motion, related to the magnetic moment, and additional to the particle energy and angular momentum. Simple analytic results were obtained for the particle and energy loss rate from a Maxwellian plasma in both plane and axisymmetric geometry, electric fields being assumed zero everywhere. The results were valid for a plasma radius large relative to the ion gyro-radius, in which case the adiabaticity in the sense used reduced the loss rate by a factor $\frac{2}{3}\lambda^{\frac{1}{2}}$, to give an overall scaling as $\lambda^{-\frac{1}{2}}$ with external mirror ratio λ. The absolute value was about a factor two less than the previously accepted result (for $\lambda = 1$ only) for an axisymmetric cusp. The enhanced scaling with λ arose from the absence of a certain class of particles in the sheath, which must be everywhere adiabatic; its applicability to a simple theta pinch was queried, however. The end loss rate of angular momentum was also obtained, and was non-zero at a point cusp. This was shown to lead to rapid rotational instability in a collisionless theta pinch. (auth)

25713 MASS MOTION AND HEATING IN A MAGNETIC NEUTRAL POINT SYSTEM. Baum, P. J.; Bratenahl, A. (Univ. of California, Riverside). J. Plasma Phys.; 11: 93-98(Feb 1974).

Optical spectroscopic and magnetic probe observations of a laboratory discharge device, in which magnetic field line reconnection occurs at an x-type neutral point, were presented. Time-resolved spectral-line profiles of the ionized argon line AII λ 4348 were presented. These allowed the determination of Doppler shifts and broadenings near the neutral point. Plasma heating occurred at the neutral point and downstream from it. Plasma was ejected from the downstream sides of the neutral point region at the local Alfven speed at all times. This was equal to about one-tenth the upstream Alfven speed at the one time it is known. The downstream magnetic Mach number or "local reconnection rate" was found to be nearly independent of the plasma conductivity and time. The rate of transfer of magnetic flux from the upstream to downstream regions was strongly dependent on conductivity and time. (auth)

Diagnostics

Refer also to abstract 25149.

25714 (AD-764496) SPECTROMETRIC AND PHOTOGRAPHIC ANALYSIS OF A LASER-PRODUCED HYDROGEN PLASMA. Wachsmuth, K. D. (Naval Postgraduate School, Monterey, Calif. (USA)). Jun 1973. 50p. NTIS $4.50.

Thesis.

Light from a neodymium glass laser was focused in hydrogen gas at pressures from 20 m torr to 9.16 atm in order to produce optical breakdown. The forward scattered light from the breakdown region was spectrally analyzed with a grating spectograph from 10,300 to 10,900 Å. It was found that the spectral distributions exhibited no distinguishable frequency shift. However, the absorption of the laser light depended on frequency and gas pressure. The time dependence of the onset of absorption was determined by comparing the cell beam with a beam-splitted reference beam that bypassed the pressure cell. The light scattered at an angle of 90 was photographed with a high speed image converter camera in the framing mode. This revealed evidence of self-focusing during the time the laser light was on. The plasma parameters were calculated from the kinetic theory of ideal gases and the theory of ionized gases, assuming complete ionization. (auth)

25715 (AD-766654-8) ELECTRON DENSITY MEASUREMENTS AT HIGH PRESSURES. Rudderow, W. H. (Advanced Technology Center, Inc., Arlington, Tex. (USA)). Jun 1973. Contract F19628-73-C-0140. 32p. (AFCRL-TR-73-436). NTIS $3.75.

Measurements of the electron density in the flow produced by high velocity shock waves in air at initial pressures of 5 torr and 10 torr were performed in an electromagnetic shock tube. The current collected by flush-mounted probes mounted in the wall of a rectangular cross section shock tube were used to deduce the electron density. Measurements were performed where the probes were biased to collect either ion current or electron current, and a simple theory was used to describe the probe characteristics. The flow conditions surrounding the probe were computed with engineering approximations of the wall boundary layer. A comparison of the measured results and the predicted values agree within a factor of two. Additional measurements of the current collected by a stagnation point electrostatic probe were also performed. Using simple theories, the measured electron density agrees with theoretical predictions within a factor of three. (auth)

25716 (EUR-CEA-FC-699) ELECTRIC FIELDS PARALLEL TO THE MAGNETIC FIELD IN A STRONGLY ANISOTROPIC PLASMA IN A MAGNETIC MIRROR FIELD. Geller, R.; Hopfgarten, N.; Jacquot, B.; Jacquot, C. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service d'Ionique Generale). Jun 1973. 52p. Dep. NTIS (U. S. Sales Only) $4.75.

Using electrostatic probes, the electric field component, $E_{||}$, along the magnetic field was comprehensively investigated in a collisionless plasma. The plasma is produced by means of electron cyclotron resonance in a microwave cavity located in the magnetic field gradient in one half of a magnetic mirror field. The measurements show that a stationary $E_{||}$ exists everywhere in the plasma where the magnetic field gradient, $\text{grad}_{||}B$, in the direction of the field is different from zero. The direction of $E_{||}$ is opposite to that of $\text{grad}_{||}B$. The plasma is strongly anisotropic with the energy of the ions essentially parallel to the magnetic field and the electron energy mainly perpendicular to it. Thus, in the plasma the ion and electron pitch-angle distributions are forced to be different and $E_{||}$ is created as a consequence. In this way an experimental demonstration is presented of the theoretically predicted relation between $E_{||}$ and the pitch-angle distributions. Experiments with imposed radial electric fields, E_r, (fields perpendicular to the magnetic field), show that, for sufficiently strong E_r inside the plasma, the distribution of the potential along the magnetic field is deformed. This deformation is probably due to changes in the particle distributions caused by the imposed E_r. As the neutral gas pressure is increased $E_{||}$ decreases successively. In terms of the mean free path, λ, for the dominating collision process, it is found that $\lambda > 5$ to 10 L is a necessary condition for the existence of $E_{||}$ in the experiment. L is twice the distance between the cavity and the midplane of the mirror field. For proper experimental conditions $E_{||}$ is proportional to $\text{grad}_{||} B$ all the way along the magnetic field, from the cavity to a position 1 to 2 cm in front of the location of the magnetic field maximum in the mirror opposite to the cavity side. Under these circumstances the magnitude of $E_{||}$ is 40 to 80% of the value theoretically predicted to exist in a collisionless plasma in a magnetic mirror field, when all particles of each species have the same velocity direction and magnitude. (auth)

25717 (EUR-CEA-FC-701) CHARGE EXCHANGE WITH EXCITATION OF THE HYDROGEN ATOM BY H^+ AND H_2^+ ION IMPACT ON NEUTRAL GASES. Measurement of the Proton Density of a Plasma Beam. Hess, W. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Jun 1973. 74p. (In French). Dep. NTIS (U. S. Sales Only) $5.75.

Thesis.

Absolute cross sections for electron capture into the $n = 3$ and 4 states of H were measured from 0.3 to 3.0 keV for H^+ and H_2^+ impact on gaseous H_2, He, CO_2, N_2, Ar. The Balmer α and β cross sections decrease exponentially with decreasing impact energy according to the following relation $\sigma \doteq A \exp. (-B/\Delta E/v_{(+)}$ where ΔE is the internal energy of the reaction, $v_{(+)}$ the ion velocity, and A and B are constants. An optical technique, using the Doppler shifted Balmer line $H_{(\beta)}$ due to the reaction $H^+ + N_2 \rightarrow H\ (n = 4) + N_2^+$ was used to measure the energy and density of the protons of a hot plasma beam. (FR)

25718 HOLOGRAPHIC INTERFEROMETRY OF EXPLODING WIRES. Seftor, J.L. (Air Force Weapons Laboratory, Kirtland AFB, New Mexico 87117). J. Appl. Phys. 44: No. 11, 4965-4969 (Nov 1973).

A short (2-nsec) pulse ruby laser has been used to make holographic interferograms of exploding-wire events. At atmospheric pressure the interferograms exhibit both shock waves and ionization. In a vacuum the vaporization and subsequent ionization of the wire are evident. At selected times after initiation, spatial electron density profiles have been calculated via an Abel inversion, with peak densities approaching 10^{19} cm^{-3}. (auth)

25719 RADIAL NEUTRAL GAS TEMPERATURE AND DENSITY PROFILES IN LOW-PRESSURE ARGON DISCHARGES. Eden, J.G.; Cherrington, B.E. (Gaseous Electronics Laboratory, Department of Electrical Engineering, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). J. Appl. Phys. 44: No. 11, 4920-4926 (Nov 1973).

In this paper we describe the direct measurement of the neutral gas density and the determination of the neutral temperature profiles in a low-pressure weakly ionized argon discharge. The measurements were made using a single-wavelength coupled cavity laser interferometer to study the neutral density variations in the afterglow of a crowbarred dc (steady-state) discharge. The temporal and radial variations of the neutral gas density in the afterglow were used to infer the dc steady-state gas density and temperature profiles, assuming an ideal gas. It is shown that the profiles are strongly current and pressure dependent and that the axial depletion of neutrals can be as high as 25-30%. Long neutral relaxation times (2-3 msec) were encountered in order to reach thermal equilibrium in the afterglow for the pressures and currents studied (1-10 Torr, 50-350 mA). Radial profiles of the neutral gas density for a fixed pressure and current are in agreement with the hypothesis that neutral heating is caused primarily by collisions with the electron gas, resulting in a convective flow of the hot neutrals radially outward towards the cooler walls. (auth)

25720 OPTICAL DIAGNOSTICS OF AN ECRH PLASMA. Eastlund, B.J.; Spero, D.; Johnson, M.; Korn, P.; Wharton, C.B.; Wilson, E.R. (Laboratory of Plasma Studies, Cornell University, Ithaca, New York 14850). J. Appl. Phys. 44: No. 11, 4930-4935 (Nov 1973).

Line ratios and absolute intensities of helium singlet and triplet states are used to determine the electron temperature and number density of an electron cyclotron resonance heated (ECRH) plasma. Excitation rates and line ratios are calculated using the best available cross-section information. An averaging technique based on absolute intensities is used to determine the temperature. This technique permits an experimental calibration of line ratios. In particular, the ratio of the 4713-Å intensity to the 4921-Å intensity is found to be strongly dependent on electron and neutral atom number densities. The ratio of the intensities of the 5048- and 4713-Å lines is also studied. These results show that the helium line ratios can be used to obtain accurate information on the temperature and number density of an ECRH plasma. (auth)

25721 DETERMINATION OF THE PARAMETERS OF A FLUCTUATING PLASMA FROM MODULATION OF A MICROWAVE SIGNAL. Dushin, L.A.; Skibenko, A.I.; Fomin, I.P. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.-Tech. Phys. 18: No. 2, 207-210 (Aug 1973).

The modulation of an electromagnetic wave by fluctuations of the electron density is described. Analytical relations are obtained under the assumption that the fluctuation frequency and the effective collision frequency are small compared with the frequency of the electromagnetic wave. Using the modulation factor it is possible to find the mean statistical value and the mean-square fluctuations of the electron density in a given interval of time. Experimental investigations have been performed on the decaying plasma of a pulsed reflex discharge in a metal chamber at 4, 8, and 13 mm. Measurements with a double electric probe to determine the fluctuations of the electric field in the plasma simultaneously with the microwave measurements are used to investigate the relation between the modulation of the transmitted wave and the electric field in the plasma. (auth)

25722 INTERPRETATION OF ELECTROSTATIC PROBE DATA TAKEN IN A FLOWING PLASMA. Huggins, R.W. (Bell Laboratories, Whippany, New Jersey 07981). J. Appl. Phys. 45: No. 2, 710-716 (Feb 1974).

Electrostatic probe measurements taken under continuum conditions in a flowing ionized gas can overestimate the charged-particle density by several orders of magnitude if the convection of charged particles into the plasma sheath is not included in the analysis. A simple physical model which includes both diffusion and convection currents is described, together with an experiment in which charged-particle densities inferred from spherical and disk probes were compared to microwave electron density measurements. The experiment was performed in a room-temperature flowing afterglow plasma over a Reynolds number range 0.4-70 under thick-plasma-sheath conditions. The agreement between the microwave and the spherical probes' ion current measurements was within 30%, and the ion current-voltage characteristic was described to better than 10% at both a high and low Reynolds numbers. The interpretation of electron current data is also discussed. (auth)

25723 ORIFICE PROBE FOR PLASMA DIAGNOSTICS. II. Multiparameter Analysis. Prokopenko, S. M. L.; Laframboise, J. G.; Goodings, J. M. (Univ. of Toronto). J. Phys., D (London); 7: No. 2, 355-362(21 Jan 1974).

A multi-grid orifice probe and analysis technique are presented which permit the measurement of the following plasma parameters: the electron number density n_e, the electron temperature T_e, the space potential V_s, and an estimate of the metastable number density n_m. Simultaneously, the analysis allows the quantitative determination of instrumental parameters such as the reflection coefficient for slow (<30 eV) electrons from the grids $R_e(G)$ and roughened (gold-black) collector $R_e(C)$, the secondary electron emission coefficient for fast (>30 eV) electrons $\gamma_e(G)$ from the grids, and the effective transparencies of the grids for electrons $\tau_e(G)$, and for metastables $\tau_m(G)$. Experimental ion, electron, and total current characteristics are presented for a low-pressure (1.8×10^{-2} torr) rf discharge in argon. The major part of the analysis method involves the use of ten "plateau values" obtained from the characteristics to determine values for most of these parameters. T_e and V_s are determined separately. The values obtained are: $n_e = 2.74 \times 10^9$ cm^{-3} ± 18%, $kT_e = 1.92$ eV ± 5%, $V_s = 11.7 \pm 0.1$ V, $n_m \simeq 3.3 \times 10^9$ cm^{-3} ± 50%, $R_e(G) = 0.65 \pm 0.10$, $R_e(C) = 0.22 \pm 0.10$, $\gamma_e(G) = 0.935 \pm 0.010$, $\tau_e(G) = 0.830 \pm 0.002$, and $\tau_m(G) = 0.850 \pm 0.002$. The transparencies $\tau_e(G)$ and $\tau_m(G)$ are within 4% of the geometrical transparency $\tau(G) = 0.860$. Approximately equal numbers of atoms (1 in 2×10^5) are in metastable and ionized states. (auth)

25724 DETECTION OF WEAK THOMSON SCATTERED RADIATION FROM A MAGNETIZED ARC USING A CW ARGON ION LASER. Doebele, H. F.; Kirsch, K. (Univ., Stuttgart). Phys. Lett., 46A: No: 5, 352-354(14 Jan 1974).

Electron temperature and density in a hydrogen arc are measured by 90° Thomson scattering, using a cw-laser with 2 watt at 5145 Å. Synchronous detection is employed to retrieve the scattered signal from more than four orders of magnitude plasma radiation. (auth)

25725 ELECTRIC PROBES IN STATIONARY AND FLOWING PLASMAS. Part I. Collisionless and Transitional Probes. Chung, P. M. (Univ. of Illinois, Chicago); Talbot, L.; Touryan, K. J. AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 12: No. 2, 133-144(Feb 1974).

The operation and theory for collisionless and transitional electric probes are reviewed. The following topics are discussed: (1) orbital motion limit, (2) cold ion approximation, (3) exact theories for current collection by spherical and cylindrical probes in the collisionless limit, (4) collisional effects on probe response, and (5) the effect of flow on aligned cylindrical probes under collisionless conditions. (MOW)

25726 ABSORPTION COEFFICIENTS OF A HYDROGEN PLASMA FOR LASER RADIATION. Stallcop, J. R. (Ames Research Center, Moffett Field, CA). J. Plasma Phys.; 11: 111-129(Feb 1974).

The formalism for the calculation of the absorption of radiation by a hydrogen plasma at common laboratory conditions was summarized. The hydrogen plasma absorption coefficient for laser radiation was computed for a wide range of electron densities (10^{15} to 10^{18} cm^{-3}) and temperatures (10,000 to 40,000°K). The results of this computation were presented in a graphical form that permitted a determination of the absorption coefficient for the following laser wavelengths: 0.176, 0.325, 0.337, 0.442, 0.488, 0.515, 0.633, 0.694, 1.06, 1.15, 2.36, 3.39, 5.40 and 10.6 μm. The application of these results and laser radiation absorption measurements to plasma diagnostics was discussed briefly. (auth)

Kinetics (General)

25727 (AD-764087) RELATIVISTIC PARTICLE MOTION IN NONUNIFORM ELECTROMAGNETIC WAVES. Schmidt, G.; Wilcox, T. (California Univ., Los Angeles (USA). Plasma Physics Group). Jun 1973. Contract N00014-69-A-0200-4023. 15p. (PPG-152). NTIS $3.00.

It is shown that a charged particle moving in a strong nonuniform electromagnetic wave suffers a net acceleration in the direction of the negative intensity gradient of the wave. Electrons will be expelled perpendicularly from narrow, laser beams and various instabilities can result. (auth)

25728 (NP-19955) COMPARISON OF ARGON AND URANIUM PLASMA TRANSPORT PROPERTY SOLUTIONS. Kane, E. L. (Sydney Univ. (Australia). Dept. of Mechanical Engineering). [nd]. 26p. Dep. NTIS (U.S. Sales Only) $3.50.

A theoretical discussion is presented of the experimental data obtained by the measurement of the electrical and thermal conductivity in a wall-stabilized uranium arc, employing argon or helium as a cover gas. An outline of the full mathematical model that is under development is given, together with numerical transport property results for separate, singly ionized uranium and argon gases at one atmosphere and temperatures ranging from 4000 to 14,000°K. Several comparative methods for the calculation of electrical conductivity, as well as viscosity, are employed. (auth)

25729 FIZIKA PLASMY I PROBLEMY UPRAVLYAEMOTO TERMOYADERNOGO SINTEZA. Vypusk 1 and 2. (Plasma Physics and Problems of Controlled Thermonuclear Synthesis. Number 1 and 2). Tolok, V. T. (Ed.). Kiev; Izdatel'stvo Naukova Dumka (1971). 307p. (In Russian).

The two volumes of the publication consist of 61 papers given at the eighth annual conference of the Physico-Technical Institute of the Academy of Science of the USSR held in May 1968 in Kharkov. All papers deal with work done at this Institute in 1967. About 25% of the papers are purely theoretical. All the others include or consist entirely of descriptions and results of experiments. A large part of the work described was in direct support of the Institute's stellerator "Uragan" program. The information contained in the books is, therefore, not a general treatise of the book title subjects or even a complete 1967 state-of-the-art report of the USSR efforts in the field. Because these meetings seem to be held annually, many papers should be reports on continuing projects and may require reading of references or even a certain familiarity with the work at the Institute for a full understanding of their contents. Nevertheless, the books contain a vast amount of detailed information on research in the field of plasma physics with emphasis on thermonuclear problems. (MOW)

25730 DIAGRAMS OF THE DISCHARGE WITH OSCILLATING ELECTRONS. Reikhrudelv, E. M.; Smirnitskaya, G. V.; Etiazaryan, G. A. (Moscow State Univ.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 7: No. 6, 443-448(1972). (In Russian).

On the basis of distribution measurements of different types of oscillations as well as of the electrical potential and currents, state diagrams of the discharge with oscillating electrons are constructed. (auth)

25731 NONEQUILIBRIUM OF ARC PLASMAS. Uhlenbush, J. (Technische Hochschule, Aachen). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Tekh. Nauk; No. 13, 27-39(Oct 1973). (In Russian).

Complete, local, and partial thermodynamic equilibria are examined as possible models. From experimental results it is shown that these plasma models are realizable as a function of the discharge conditions. Partial thermodynamic equilibrium is considered in detail. It is observed at normal pressure in He arcs. States which do not represent thermodynamic equilibrium are also examined. The conditions on the chamber walls are discussed. It is shown that at very high thermal flux the assumption on the Maxwell distribution of the velocity is unjustified. (tr-auth)

Kinetics (Experimental)

25732 (AD-763808) DIFFUSION WAVE TECHNIQUE APPLIED TO A MAGNETIZED HELIUM POSITIVE COLUMN PLASMA. Richardson, R. W. (Colorado Univ., Boulder (USA)). 1973. 110p. (AFOSR-TR-73-1141). NTIS $7.50.

Thesis.

A new technique was developed for exciting a one-dimensional diffusion wave transverse to the magnetic field in an active helium positive column plasma. A modulated electron beam is used to produce a sinusoidal plasma density perturbation along the axis of a quiet magnetized helium positive column plasma. The perturbation in plasma density dissipates radially from the axis as a diffusion wave. Radial profiles of amplitude and phase of the perturbation are measured with a movable Langmuir probe input to a phase-lock amplifier. The transverse diffusion coefficient is obtained by fitting a diffusion model to the amplitude and phase profiles. (auth)

25733 EXPERIMENTAL INVESTIGATION OF THE INTERACTION BETWEEN PLASMA FLUXES AND A SPATIALLY-PERIODIC MAGNETIC FIELD. Azovskii, Yu. S.; Guzhovskii, I. T. Fiz. Plazmy Probl. Upr. Termoyad. Sin.; No. 4, 59-67(1973). (In Russian).

25734 EXPERIMENTAL INVESTIGATION OF THE DEPENDENCE OF THE TEMPERATURE AND ELECTRON CONCENTRATION ON THE COMPOSITION OF THE ARC PLASMA. Vysokava, I. L.; Shvangiradze, R. R. Zh. Prikl. Spektrosk.; 19: No. 6, 1006-1009(Dec 1973). (In Russian).

It is shown experimentally that the dependence of the temperature of the arc plasma on the concentration of slightly ionized components has a nonmonotonic character. The order of magnitude of the concentration of the slightly ionized component is determined in samples (~0.1%) with which a substantial decrease of the temperature and growth of electron concentration begin. It is shown that at >3% of slightly ionized components stabilization of the plasma parameters occurs. In connection with the dependence obtained of the temperature and electron concentration on the plasma composition the micro and macro components of the plasma are determined. Experimental data are reported on the mutual correlation of the temperature and electron concentration as a function of the plasma composition. The relation $n_e(T)$ is not unique and depends on the qualitative and quantitative composition of the plasma with respect to slightly ionized components. (tr-auth)

25735 CHANGE OF PLASMA PARAMETERS DURING ACCELERATION IN A STANDING ELECTROMAGNETIC WAVE. Koehne, R. Stuttgart; Univ. Stuttgart (1972). 99p. (In German).

Thesis.

Following the setup and testing of spectroscopic measuring equipment with time-dependent and spatial resolution, the behavior of the parameters of a plasmoid during acceleration by a standing electromagnetic wave was studied. The wave was generated by discharging a condenser battery via a coil with a sine-shaped current density distribution (sinusoidal coil) achieved by an appropriate winding of the coil. The plasmoid was observed over a measuring range of about 70 cm. Since it could not be excluded that the observed interference phenomena between the electromagnetic fields of the plasma-generating conical coil and the sinusoidal coil might affect the plasma parameters, the latter were investigated at various phase relationships of both coils, and measurements of the magnetic field were performed under vacuum. The optical velocity measurements have been compared with measurements by a piezoelectric probe which was also used to determine the particle density. It was found that the influence of the phase relationships on the plasma parameters is negligible, and that the sinusoidal coil has no effect on the shape of the plasmoid. Over the first 40 cm, the plasmoid is approximately toroidal in shape, with a maximum electron density N_e of $2 \times 10^{16}/cm^3$, an electron temperature T_e of 50,000°K and an electric conductivity sigma of 20,000 S/m. Then this geometry gradually disappears, N_e, T_e and sigma fall to values of about $3 \times 10^{15}/cm^3$, 39,500°K and 17,000 S/m. In experiments without the sinusoidal coil, these values have been smaller, which means that in addition to acceleration, this coil system has an additional heating effect on the plasmoid. The experimentally determined acceleration from 30 km/s to about 57 km/s is in good agreement with theoretical data. Due to the spatial extension of the sinusoidal coil and its additional heating effect, this system has a much better efficiency than a system with conical coil alone, and therefore lends itself to experiments for the simulation of re-entry processes. (GE)

Kinetics (Theoretical)

25736 (AD-763826) COMPUTER SIMULATION OF ELECTROSTATIC INERTIAL CONFINEMENT. Final Report. Barnes, C. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Jun 1973. Contract F44620-71-C-0005. 42p. (SU-IPR-527; AFOSR-TR-73-1117). NTIS $3.00.

The technique of numerical plasma simulation is here used to study the behavior of the electrostatic-inertial confinement device. Particle type simulation models calculate the time evolution of the plasma contained within a spherical chamber into which high energy ions are radially injected. Two types of steady state configurations were found to exist, one of which includes a virtual anode. Neither allows a particle density enhancement over that due to geometrical focusing. (auth)

25737 (EUR-CEA-FC-708) PROBLEMS AND NUMERICAL METHODS IN VERY HIGH TEMPERATURE PLASMA PHYSICS. Mercier, C.; Adam, J. C.; Soubbaramayer; Soule, J. L. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Oct 1973. 44p. (In French). Dep. NTIS (U. S. Sales Only) $4.25.

From international colloquium on scientific and technical calculation methods; Rocquencourt, France (17 Dec 1973).

The chief methods used for the numerical study of plasmas at very high temperatures are presented (Vlasov equation and Lagrangian models). One-dimensional models for weak turbulence were tested in a large number of numerical experiments. Qualitative results predicted by theory have been reestablished in this way. Many theoretically predicted microinstabilities, which have never been experimentally observed, were observed in these numerical simulations. In the field of strong turbulence, studies of the double beam instability, which cannot be treated theoretically, were conducted in a detailed manner. One-dimensional models are, however, too restrictive to be used in studies of confined plasmas. In particular, studies of the transport coefficients necessitate two- and three-dimensional models. (FR)

25738 (EUR-CEA-FC-709) VARIOUS APPROXIMATIONS TO THE PROBLEM OF STRONG TURBULENCE IN PLASMAS. Rolland, P. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Oct 1973. 44p. (In French). Dep. NTIS (U. S. Sales Only) $4.25.

Various approximations to the problem of strong turbulence in plasmas are examined. The difficulties encountered in conventional perturbation theories are discussed together with the problems raised by stochastic theories based on propagator methods. The theories of Dupree, Weinstock, Thomson, and Misguish are presented and compared, an attempt being made to determine the physical content and limitations of the method. Expansions of various propagators are given in terms of other propagators in order to demonstrate the connections between the different formalisms. (FR)

25739 (FRNC-TH-421) STUDY AND NUMERICAL RESOLUTION OF THE BOLTZMANN EQUATION FOR A WEAKLY IONIZED GAS IN A HETEROGENEOUS MEDIUM AND A STATIONARY REGIME. Keller, R. (Toulouse-3 Univ., 31 (France)). 1973. 105p. (In French). Dep. NTIS (U. S. Sales Only) $7.25.

Thesis.

The Boltzmann equation for weakly ionized gases is solved in an heterogeneous medium with a uniform field starting from the equation along the characteristic curves defined by the free motion of electrons between two collisions. It is shown that it is possible to define a single characteristic lattice for any value of the electric field and initial electron energy at the cathode. The lattice structure, for an electron energy distribution at the cathode having a sufficiently fast rate of decrease, exhibits an energy distribution with a succession of peaks and valleys due to the existence of inelastic collisions. The numerical solution of the Boltzmann equation for which a stable consistent and convergent scheme is proposed, allows these phenomena to be explained. The resulting distribution function is presented in relief. Curves are given for the variation of the electron transmission coefficient as a function of both the E/P ratio and the initial value ϵ_0 of the energy at the cathode. The changes in the electron angular distribution along the characteristic curves are also given. (FR)

25740 (NP-19954) SIMPLE AXIAL MAGNETIC FIELD, RADIAL DISCHARGE, ROTATING FLOW MODEL. Kane, E. L. (Sydney Univ. (Australia). Dept. of Mechanical Engineering). [nd]. 34p. Dep. NTIS (U.S. Sales Only) $3.75.

The driving of discharge-ionized atmospheric air in a narrow annular-cylindrical space is considered assuming the two extremes of a diffuse continuum discharge of equal strength throughout the annular region and a single localized arc. The average tangential velocity of the small experimental device continuum solution is quite close to the empirically correlated arc velocity. Progressive solution divergences are found for higher source voltage configurations. It is shown that a large radial pressure differential, necessary for centrifugal isotope separation, is only attained with source voltages of the order of 10^4 volts. (auth)

25741 (UCRL-74811) NUMERICAL SIMULATION OF THE HIGH DENSITY APPROACH TO LASER-FUSION. Zimmerman, G. V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Oct 1973. 25p. (CONF-731101-54). Dep. NTIS $3.25.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

Physical processes important to laser-fusion are discussed along with the models of these processes used by the LASNEX code. Arguments are presented to show the validity of diffusion theory and calculational results are compared to a more detailed transport method and to several experimental observations. A study of stability and symmetry results in a full two-dimensional calculation of a typical laser-fusion pellet. (auth)

25742 POSSIBILITY OF THE AMPLIFICATION OF THE RADIATION AT THE WAVE LENGTH λ = 1776 A IN RECOMBINING PLASMA. Gudzenko, L. I.; Evstigneev, V. V.; Yakovlenko, S. I. Kratk. Soobshch. Fiz.; No. 9, 23-27(Sep 1973). (In Russian).

A calculation is made of the characteristics of the amplification of the radiation in the vaccum ultraviolet spectral range in the 2s–2p transition of Be ions in supercooled (intensely recombining) dense Be plasma. (tr-auth)

25743 NONLINEAR DENSITY-MATRIX EQUATION FOR ELECTRONS IN A WEAKLY IONIZED PLASMA. Willett, J.E.; Gorham, J.W. Jr. (Department of Physics, University of Missouri, Columbia, Missouri 65201). J. Appl. Phys. 45: No. 2, 717-720 (Feb 1974).

A derivation of a density-matrix equation of motion exact to all orders in the driving field is presented for a system of dynamically independent electrons interacting with a set of randomly distributed static scattering centers. Nonlinear "driving", "collision", and "interference" terms are exhibited. An expansion of the equation of motion through second order in the field is readily obtained from the exact nonlinear equation. (auth)

25744 PROFILE OF SPECTRAL LINES OF PLASMA IONS HAVING RADIAL OSCILLATION. Dontsov, Yu. P.; Zavenyagin, Yu. A. Zh. Prikl. Spektrosk.; 19: No. 6, 1001-1005(Dec 1973). (In Russian).

The profiles of spectral lines, investigating the Doppler broadening as a result of the oscillation movement of the radiating ions in the axial-symmetric electric field of the plasma, are calculated. The character of the dependence of the magnitude of the ion concentration and their rate of excitation on the radius is taken into consideration in the calculation. (tr-auth)

25745 EXTENSION OF DOUGHERTY'S MODEL FOKKER-PLANCK EQUATION FOR A PLASMA. Papa, R. J. (Air Force Cambridge Research Labs., L. G. Hanscom Field, MA). J. Plasma Phys.; 11: 11-35(Feb 1974).

A generalization of the Appleton–Hartree equation was made to include the effects of energy-dependent electron–neutron collisions, Coulomb encounters and spatial dispersion. The frequency of electromagnetic waves propagating in a magnetoplasma is sufficiently high that the ion motion may be neglected compared with the electron motion. The present analysis extended Dougherty (Dougherty, J. P., 1963, J. Fluid Mech. 16, 126; Dougherty, J. P., 1964, Phys. Fluids, 7, 1788) to include the simultaneous effect on wave propagation of Coulomb forces, spatial dispersion and energy-dependent electron-neutral collisions, where one or more of these effects could have a significant influence on circularly polarized waves propagating at frequencies near electron cyclotron resonance. The electrical conductivity tensor was expressible in terms of appropriate velocity moments of the electron distribution function. The electron velocity distribution function was determined by expanding the inverse of the differential operator of the linearized kinetic equation in a small parameter ϵ_2, where in one case ϵ_2 was the ratio of Coulomb collision frequency to signal frequency, and in the second case ϵ_2 was the ratio of electron-neutral collision frequency to signal frequency. For wave propagation along the magnetic field, the dispersion relation for longitudinal waves were solved numerically, and graphs were presented to show the effects of collisionless damping, velocity dependent electron–neutral collisions and Coulomb collisions. (auth)

25746 TRANSPORT PROPERTIES OF THE THREE-DIMENSIONAL GUIDING CENTER PLASMA. Vahala, G. (New York Univ., NY). J. Plasma Phys.; 11: 159-171(Feb 1974).

Equilibrium and nonequilibrium properties of the three-dimensional guiding-center plasma (in which the particles move with the guiding-center drift across constant magnetic field lines, and according to Newton's laws along the field lines) were investigated. In equilibrium, the transverse spatial diffusion and conductivity coefficients were calculated, and were shown to be related via a generalized Einstein relation. The diffusion coefficient consisted of a Bohm-like 1/B contribution which tended to zero as the plasma volume tended to infinity, as well as a classical $1/B^2$ contribution, which was independent of the size of the system. The Gibbs ensemble was constructed, and it was seen that thermal equilibrium results for the pair correlation, fluctuation spectra etc. were exactly the same as for the three-dimensional unmagnetized plasma. In the nonequilibrium case the appropriate Liouville equation and BBGKY hierarchy were considered. It was shown that to first order there was no tendency for the system (assumed spatially uniform) to relax towards thermal equilibrium. (auth)

Production

Refer also to abstracts 25707 and 25714.

25747 (AD-765313-2) USE OF AN ELECTRON BEAM FOR PREIONIZATION IN THE Z-PINCH EXPERIMENT. Ott, E.; Lee, R. (Naval Research Lab., Washington, D. C. (USA)). Jun 1973. 15p. (NRL-MR-2591). NTIS $3.00.

In the z-pinch experiment, a discharge of several mega-amps is initiated along a preionized filament in high density hydrogen gas. As presently proposed the preionized filament will be created by a high power laser focused in the gas. An electron beam is considered as an alternative to the laser system now used. It was found that a relativistic electron beam with very modest energy and current characteristic can produce a preionized column of plasma with the desired initial properties. (auth)

25748 (AD-766731-4) COLLISIONAL COUPLING IN COUNTERSTREAMING LASER-PRODUCED PLASMAS. Koopman, D. W.; Goforth, R. R. (Maryland Univ., College Park (USA). Inst. for Fluid Dynamics and Applied Mathematics). Jun 1973. Contract AT(40-1)-3819. 50p. (BN-762; AFOSR-TR-73-1590). NTIS $4.50.

The collisional mechanisms by which a high density expanding plasma transfers momentum to an ambient stationary background are examined, and applied to the example of a laser-produced plasma. Experimental measurements of collisional modification of the ion flow field confirm the treatment used for momentum transfer rates. A numerical model which simulates the collisional coupling of an expanding laser-produced plasma to a photoionized background is developed; the results are compared to laboratory data to assess the degree to which collisional coupling influences experimental interaction studies in which both collisionless and collisional effects may be important. (auth)

25749 (AD-766893-2) REFLECTION OF BACKGROUND IONS BY AN EXPANDING LASER-PRODUCED PLASMA. Goforth, R. R.; Koopman, D. W. (Maryland Univ., College Park (USA). Inst. for Fluid Dynamics and Applied Mathematics). Apr 1973. Contract AT(40-1)-3819. 59p. (BN-763; AFOSR-TR-73-1592). NTIS $3.50.

A mass-spectroscopic study of a precursor feature, which propagates ahead of a laser-produced plasma expanding into a partially ionized background, has confirmed that the feature comprises fast ions of the background gas species. The maximum velocity of the precursor ions is found to be V (MAX) about ±2 mu/M (V_{LE}), where mu/M is the ratio of reduced mass to background ion mass and (V_{LE}) is the leading edge velocity of the laser-produced plasma; the precursor ions therefore appear to result from two-body collisions. A theoretical model which includes screened-nuclear cross-sections and friction due to multiple small-angle collisions indicates that hard-knock ion-ion collisions are insufficient to explain the large precursor ion flux which is experimentally observed. The experimental results are in satisfactory agreement with a model which invokes ion-neutral rearrangement collisions for generation of the precursor ions. (auth)

25750 (AD-767683-6-GA) PRESSURE DEPENDENCE OF SPONTANEOUS MAGNETIC FIELDS IN LASER PRODUCED PLASMAS. Bird, R. S. (Naval Postgraduate School, Monterey, Calif. (USA)). Jun 1973. 146p. NTIS $9.50.

Thesis.

A plasma was produced by irradiation of an aluminum slab with a 6.6 joule, 22 nanosecond (10^{10} W/cm^2) pulse of 1.06 micrometer radiation. Magnetic fields were observed to arise spontaneously when the laser-produced plasma was formed. The space and time behavior of the spontaneous magnetic fields and their relationship to the plasma density profile for expansion into various background pressures of H_2, He, N_2 and Ar was investigated using magnetic and electrostatic (double) probes. The magnitude and direction of the magnetic fields was found to depend on the background gas pressure. The generation of spontaneous magnetic fields at the front of the expanding laser plasma was observed long after laser irradiation ceased. These fields were axially symmetric and in a direction opposite to the initial field direction. Reverse fields were observed only above a critical background gas pressure. Magnetic fields were also observed to arise when a laser plasma impinged on a glass plate. The observed increase of the magnitude of the initial spontaneous magnetic fields is interpreted as arising from the momentum interaction between the expanding laser plasma and the pre-ionized ambient background plasma. The reverse field is attributed to the development of an axial electron temperature gradient at the plasma front due to snowplowing of the ambient plasma. (auth)

25751 (IPP-IV-62) CLASSICAL REFLECTION IN A HYDRODYNAMIC MODEL OF LASER PLASMA INTERACTION. Cojocaru, E.; Mulser, P. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Oct 1973. 28p. (In German). Dep. NTIS (U. S. Sales Only) $3.50.

The dependence of temperature on the absorbed laser power and on the ion charge in laser-produced plasma was theoretically investigated in plane and spherical geometry for Nd laser intensities from $\phi_0 = 10^{13}$ to 10^{15}W/cm^2 in rectangular pulse form. The classical reflection coefficient R_Z was found to be connected with that of deuterium by the power law $R_Z = R_D^{Z^{4/9}}$. It follows that classical reflection cannot be effectively suppressed by seeding targets with high Z materials. (auth)

25752 GENERATION OF HIGH-ENERGY PLASMAS BY ELECTROMAGNETIC IMPLOSION. Turchi, P.J.; Baker, W.L. (Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico 87117). J. Appl. Phys. 44: No. 11, 4936-4945 (Nov 1973).

Multimegajoule high–temperature high–Z plasmas are of interest as high–intensity radiation sources for use in a number of applications. This paper describes a possible method of generating such plasmas by means of the $\vec{j} \times \vec{B}$ driven implosion of thin metallic foil cylinders. Basic analytical guidelines are developed and the results of numerical computations are displayed. Experimental problems associated with the creation of high–energy plasmas by this technique are discussed with some initial experimental results presented. (auth)

25753 X-RAY POINT-SOURCE PROJECTION PHOTOGRAPHY WITH A LASER-PRODUCED SOURCE. Holzrichter, J.F.; Dozier, C.M.; McMahon, J.M. (Naval Research Laboratory, Washington, D. C. 20375). Appl. Phys. Lett. 23: No. 12, 687-689 (15 Dec 1973).

Laser–produced plasmas are shown to have characteristics useful for high–resolution subnanosecond x–ray radiography. Plasmas produced by 3–J subnanosecond 1.06–μm laser pulses focused onto an Al target emit x rays ($\gtrsim$ 1.5 keV) from a 50-μm-diam volume in the order of 1 nsec. Such sources may be useful to probe other plasmas. (auth)

25754 EXPERIMENTAL INVESTIGATION OF THE OPTICAL PROPERTIES OF LASER EROSION PLASMA IN THE INTERACTION ZONE. Goncharov, V.K.; Min'ko, L.Y.; Tyunina, E.S.; Chumakov, A.N. Sov. J. Quantum Electron. 3: No. 1, 29-32 (July 1973).

An optical study was made of the surface plasma generated in an open interaction zone by laser radiation of $6 \cdot 10^6$ W/cm^2 density impinging on a metal. A characteristic emission of a continuous background and of spectral lines by the surface plasma was reported. It was established that the continuous background reached its maximum intensity at some height from the surface being irradiated. The transparency of the plasma was determined using an optical system in which the distribution of the transparency could be determined in a single experiment. It was found that plasma jets generated by laser erosion were optically opaque in a surface region up to 2 mm thick. The measurements were used to determine the temperature distribution along the plasma jets in the surface region (0.3–2 mm). The temperature had a maximum due to heating of the plasma jets by the laser radiation in the course of their gas–dynamic motion. This maximum indicated strong screening of the surface from the incident laser radintion. (auth)

25755 PREIONIZATION IN A TOKAMAK BY A TM MODE. Ivanov, N.V.; Kovan, I.A.; Los', E.V. Sov. Phys.–Tech. Phys. 18: No. 3, 326-327 (Sept 1973).

The characteristic modes of a hollow toroidal resonator and breakdown of a gas by the field of a TM mode are investigated. During breakdown a plasma forms near the axis of the chamber; its characteristic diameter is 10 cm and the maximum density is 5.10^8 cm^{-3}. (auth)

25756 GENERATION OF FUSION NEUTRONS IN PLASMA PRODUCED BY A STRONG LASER PULSE. Denus, S.; Jankiewicz, J.; Kaliski, S.; Kowalski, S.; Nagraba, S.; Nowakowski, W. (Military Academy of Tech., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 21: No. 11, 937-946(1973).

An experiment to produce high-temperature plasma of lithium deuteride and deuterium impregnated polyethylene and to generate neutrons of thermonuclear microfusion by a nanosecond laser pulse with an energy of 20 to 40 J is discussed. The results of the work reported mean the attainment of the world level in laser heating research and nuclear microfusion. They will be a starting point for work using the laser-focus or laser-cumulation compression systems etc., for which the critical energy of the laser pulse necessary for positive recovery of the fusion energy is reduced to a few or more than ten kJ. The measurement systems used are described (the laser system and the system for measuring the x-radiation, the reflected radiation, ion expansion, emission of neutrons, etc.). (auth)

Stability

25757 (AD-763336) TWO-DIMENSIONAL STUDY OF ELECTRON-ION STREAMING INSTABILITIES. Lampe, M.; Haber, I.; Orens, J. H.; Boris, J. P. (Naval Research Lab., Washington, D. C. (USA)). May 1973. 49p. (NRL-MR-2587). NTIS $3.00.

A two-dimensional study, based on computer simulation, of strong electron-ion streaming instabilities induced by counterstreaming ion beams, for initially cold electrons v_e mach $< v_d$ is presented. Wave growth agrees well with linear theory initially. Higher harmonics appear later, in good agreement with mode coupling theory. The wave spectrum, initially very broad perpendicular to the streaming direction, narrows as the electrons heat and the waves saturate, in accordance with quasi-linear theory. Electron heating is explained by nonresonant quasilinear diffusion at early times, and by resonant turbulent diffusion at later times. In contrast to previous one-dimensional studies, it was found that electron heating continues well after wave saturation and after $v_e > v_d$. However the heating rate at late times is somewhat reduced by partial plateau formation in the electron velocity distribution. Coherent electron trapping is not seen, as it is in the one-dimensional situation, but coherent ion trapping does occur and dominates the wave dynamics at late times, terminating wave growth on the time studied. (auth)

25758 (AD-763590) NONLINEAR DEVELOPMENT OF THE ION ACOUSTIC INSTABILITY IN A LOW PRESSURE DISCHARGE. Yamada, M. (Illinois Univ., Urbana (USA). Coordinated Science Lab.). May 1973. 129p. (UILU-ENG-73-2214). NTIS $8.50.

The linear and nonlinear stage of the ion-acoustic instability in a low pressure discharge in helium was investigated extensively. The linear stage was found to be well described by kinetic equations that include electron-neutral and ion-neutral collisions as well as the effect of a static electric field. The dispersion properties of the waves and their spatial growth rate were measured and compared with theoretical values. The detection characteristic of Langmuir probes for ion-acoustic waves was studied in detail and a theoretical model for it is proposed. Spatial saturation of the instability level was observed and its magnitude was found to be consistent with the idea that saturation is produced by trapping of electrons in the potential of the waves. (auth)

25759 (AD-763737) PARAMETRIC INSTABILITIES OF DAMPED MODES IN INHOMOGENEOUS PLASMAS. DuBois, D. F.; Williams, E. A. (Colorado Univ., Boulder (USA). Dept. of Astro-Geophysics). Apr 1973. Contract F44620-73-C-0003. 12p. (CU-1005; AFOSR-TR-73-1134). NTIS $3.00.

Using WKB analysis it is shown that for three-wave backscattering type parametric instabilities in inhomogeneous plasmas no spatial (convective) growth is possible for undamped modes. If one coupled mode is more heavily damped than the other, then spatial growth is possible in both forward and back-scattering. The spatial amplification factor is that obtained by Rosenbluth only if the pump power is sufficiently above a damping-determined threshold but below a threshold for temporal or absolute instability exists for the backscatter instabilities. For the parametric decay instability at $\omega_0 = 2\omega_{pe}$ in a finite spatial region only a temporal instability is found but no spatial (convective) growth. (auth)

25760 (AD-766921-1) TOROIDAL EQUILIBRIA OF FUSION PLASMA IN A CURVED THETA PINCH. Cantrell, E. L.; Doubal, A. A. (Texas Univ., Austin (USA). Electronics Research Center). 10 May 1973. Contract F44620-71-C-0091. 129p. (AFOSR-TR-73-1531). NTIS $8.50.

The engineering problems associated with stabilizing the plasma drift due to the magnetic field gradient in a toroidal theta pinch are studied analytically and experimentally. The analysis is developed from the Lagrangian formulation for a dynamic circuit model. Stabilization by axial currents is realized from the formulation and agrees with reported experimental results. The formulation is applied to the equilibrium system using auxiliary helical fields of 1-fold symmetry. The analysis includes image currents which are spatially periodic due to varying coil-to-wall spacing. The periodicity leads to an asymmetry in the vertical plane resulting in a destabilizing vertical force on the plasma column. A modified helical system with an axisymmetric field period twice that of helical field is proposed. Analysis demonstrates that this eliminates the undesired vertical force while preserving the horizontal force needed for equilibrium. (auth)

25761 (AD-766959-1) LABORATORY OBSERVATIONS ON ELECTROMAGNETIC SCATTERING FROM PLASMA INSTABILITIES. Final Scientific Report. Kaliszewski, T. (Battelle Columbus Labs., Ohio (USA)). Jul 1973. 51p. (AFOSR-TR-73-1593). NTIS $4.75.

Laboratory observations were made of electromagnetic scattering from low pressure, low current dc discharges to test the assertion that the low-frequency ion-acoustic waves can be observed and used for the simulation of naturally occurring instabilities. An analysis of the experimental parameters and circumstances shows that such waves should be observable, provided it is permissible to ignore the effect of collisions. Observations of the backscatter signal at X-band from nitrogen and helium discharges indicate that this is, indeed, the case. Large enhancements in the scattering cross sections, relative to the Thomson level, are observed as well as the Doppler spread and lines. The interpretation of the latter is generally consistent with the model of ion-acoustic waves being viewed by an uncollimated antenna. (auth)

25762 (COO-3004-4) REVIEW OF PARAMETRIC INSTABILITIES. Schmidt, G. (Stevens Inst. of Tech., Hoboken, N.J. (USA)). Nov 1973. Contract AT(11-1)-3004. 16p. (CONF-731135-1; SIT-271). Dep. NTIS $3.00.

From AGARD-NATO meeting; Edinburgh, Scotland, UK (Nov 1973).

Parametric instabilities produced by electromagnetic waves propagating in a magnetic field-free plasma are reviewed. The discussion is based on the use of the ponderomotive force as the basic physical mechanism responsible for these instabilities. Decay of the electromagnetic wave into an electron and ion wave, the oscillating two stream instability, filamentation instability, stimulated Raman and Brillouin scattering, resistive and reactive quasi modes can all be treated in a unified fashion, in a uniform medium. If the plasma is bounded, the threshold power is nonzero even in the absence of damping, and may be the dominant factor in determining threshold and growth rate values. The threshold for stimulated Raman scattering increases in the presence of plasma density gradients, while temperature gradients have a similar effect on simulated Brillouin scattering. The finite cross section of the pump wave determines the undamped threshold for the filamentation instability. In a nonuniform plasma stimulated Raman backscattering becomes very strong in the neighborhood of the point where the pump frequency is twice the local plasma frequency. (auth)

25763 (IPP-1-136) STABILITY OF EXACT TOROIDAL MHD EQUILIBRIUM WITH NONCIRCULAR CROSS SECTION. Herrnegger, F.; Maschke, E. K. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F.R. Germany)). Nov 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

For a toroidal plasma with vertically elongated cross section, an exact solution of the MHD equilibrium equation is constructed which satisfies the Mercier criterion on the magnetic axis. In the particular example treated in this note, the ellipticity parameter is $E = 0.15$ which corresponds to a ratio of the half axis $\bar{b}$ to a_p of the elliptical plasma cross section of 1.2. This equilibrium is Mercier-stable against localized modes for $(Rj/2B)^2$ axis < 1.25, $(l/2\pi)_{axis} < 1.23$. (auth)

25764 HIGH-PULSE-RATE GLOW-DISCHARGE STABILIZATION BY GAS FLOW. Dzakowic, G.S.; Wutzke, S.A. (Westinghouse Research Laboratories, Pittsburgh, Pennsylvania 15235). J. Appl. Phys. 44: No. 11, 5061-5063 (Nov 1973).

When a transverse-discharge CO_2 laser with forced flow is pulsed rapidly, the minimum time between arc-free pulses is substantially greater than the time predicted by the ratio of electrode width to gas velocity. The maximum pulse rate is predicted accurately by flow-model solutions that determine the time required to remove the glow-discharge products from the interelectrode space. The predictions were experimentally verified to a maximum pulse rate of 1 kHz using planar electrodes in a closed-cycle wind tunnel. (auth)

25765 DIRECTIVITY OF MICROWAVE RADIATION FROM A HIGH-CURRENT GAS DISCHARGE. Manzyuk, N.A.; Moiseev, S.S.; Rozhkov, A.M.; Suprunenko, V.A. Sov. Phys.-Tech. Phys. 18: No. 4, 550-551 (Oct 1973).

The intensity of the microwave radiation from a high-current gas discharge is investigated as a function of the angle of observation ϕ. It is shown that the radiation has a sharp directivity $(\Theta \leq 10°)$, in the direction of the axis. This directivity agrees well with the suggestion that the waves are formed at the plasma-vacuum boundary, taking account of the actual mechanisms by which plasma instabilities are excited. (auth)

25766 STABILITY OF RELATIVISTIC BEAM IN A DENSE MEDIUM. Grishin, V.K.; Sukharevskii, V.G. Sov. Phys.-Tech. Phys. 18: No. 4, 564-564 (Oct 1973).

The dispersion equation for electromagnetic oscillations is used to describe the stability of a system comprising a dense medium and a beam. The result apparently explains why the empirical data deviate from the theoretical estimates obtained from an analysis of the electrostatic oscillations. (AIP)

25767 POSITIVE COLUMN INSTABILITY DUE TO NEGATIVE IONS. Mikhalev, L.A. Sov. Phys.-Tech. Phys. 18: No. 4, 548-549 (Oct 1973).

The stability of the positive column containing a small amount of electronegative impurities is investigated. It is assumed that the negative ions are formed by sticking of electrons to the impurity atoms and are removed by recombination with positive ions of the host gas and by diffusion to the walls. It is shown that the presence of negative ions in a weakly ionized bounded plasma can lead to an instability. (auth)

25768 STELLARATOR INSTABILITY DUE TO FINITE LONGITUDINAL ELECTRON THERMAL CONDUCTIVITY. Borisov, N.D. Sov. Phys.-Tech. Phys. 18: No. 4, 546-547 (Oct 1973).

The dissipative Alfvén instability in a stellarator is analyzed. The treatment allows for the actual configuration of the magnetic field in the system. Oscillations due to the toroidal drift are excited due to the a finite longitudinal electron thermal conductivity and friction between the particles. (auth)

25769 LOCAL HYDROMAGNETIC STABILITY IN A STELLARATOR. Borisov, N.D. Sov. Phys.-Tech. Phys. 18: No. 4, 544-545 (Oct 1973).

Hydromagnetic plasma stability in a stellarator is investigated using the method of small oscillations. A necessary and sufficient criterion is found for local stability. Evidently this criterion gives the same results as general geometric stability criteria; however, it applies to a much larger class of perturbations. (auth)

25770 KINETIC INSTABILITY OF A PLASMA IN A MICROWAVE FIELD. Andreev, N.E. (P. N. Lebedev Physics Institute, Moscow). Sov. Phys.-Tech. Phys. 18: No. 4, 535-536 (Oct 1973).

The results are presented of the calculation of the threshold external microwave field, above which the plasma becomes unstable, and of the growth rate of the perturbations in the threshold region. The kinetic instability is described by the dispersion equation for the low-frequency oscillations. (AIP)

25771 SATURATION OF THE TWO-STREAM INSTABILITY BY ELECTRON TRAPPING. Fedorchenko, V.D.; Mazalov, Y.P.; Rutkevich, B.N. (Khar'kov Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR). Sov. Phys.-Tech. Phys. 18: No. 4, 448-451 (Oct 1973).

Experimental data are given that indicate instability saturation in a system consisting of an electron beam and a plasma. Amplification of the wave terminates when a certain critical intensity is reached. This critical intensity depends on the composition of the plasma; in a xenon plasma it is higher by a factor of 7 than in argon. Measurements show that the energy spread of the electrons of the plasma is sufficiently large for the fastest electrons to be trapped by the wave. The instability is stabilized when an appreciable fraction of the electrons has been captured. In argon the energy spread is twice that for xenon. This result provides a natural explanation of the observed difference between the critical amplitudes in xenon and argon if it is assumed that the stabilization mechanism is the trapping and acceleration of plasma electrons by the wave. (auth)

25772 ELECTROSTATIC INSTABILITIES IN A HOT-ELECTRON PLASMA. Egorenkov, V.D. Sov. Phys.-Tech. Phys. 18: No. 2, 176-177 (Aug 1973).

Oscillations in a cold plasma which contains a small group of hot electrons are studied in the frequency region below the electron-cyclotron frequency. If the hot electron velocity distribution function is anisotropic, Alfvén waves and fast magnetoacoustic waves and whistlers are aperiodically unstable for a hot electron pressure of the order of the magnetic pressure. The instability conditions and growth rate are determined. (auth)

25773 THERMAL FLUTE PERTURBATIONS IN AN OPEN PLASMA DEVICE WITH FEEDBACK. Selidovkin, A.D. Sov. Phys.-Tech. Phys. 18: No. 3, 318-321 (Sept 1973).

The fluctuations in the electric potential near the cylindrical boundary of a collisionless plasma in a uniform magnetic field are analyzed. The curvature of the magnetic lines of force is allowed for by introducing a radial gravitational field. It is shown that the intensity and width of the fluctuation spectrum is determined by the damping of the flute perturbations in both the plasma and the feedback system. The numerical values of the fluctuation are small. (auth)

25774 ELECTROMAGNETIC INSTABILITIES IN A PLASMA WITH A TRANSVERSE CURRENT. II. Pyatak, A.I.; Sizonenko, V.L.; Stepanov, K.N. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.-Tech. Phys. 18: No. 3, 309-311 (Sept 1973).

The excitation of electromagnetic oscillations is studied in a plasma with a current that flows at right angles to the external magnetic field when $\beta_e = 4\pi n_0 T_e/B_0^2 < 1$. In a nonisothermal plasma with hot electrons and cold ions $(T_e > T_i)$ both the shortwave $(q \equiv \omega^2_{pe}/k^2c^2 < 1)$ ion-acoustic oscillations and longwave electromagnetic oscillations $(q \gtrsim 1)$ (phase velocity along the magnetic field the same order as the electron thermal velocity) can be excited. Electromagnetic oscillations in an isothermal plasma $(T_e \simeq T_i)$ are also analyzed. (auth)

25775 ELECTROMAGNETIC INSTABILITIES IN A PLASMA WITH A TRANSVERSE CURRENT. I. Pyatak, A.I.; Sizonenko, V.L.; Stepanov, K.N. Sov. Phys.-Tech. Phys. 18: No. 3, 304-308 (Sept 1973).

The excitation of small-scale electromagnetic oscillations is studied in a plasma with a current that flows at right angles to an external magnetic field with $B_e = 4\pi n_0 T_e/B_0^2 < 1$. If the relative velocity of the electrons and ions is appreciably lower than the electron thermal velocity, but greater than some critical value, oscillations are excited in the plasma with frequency and growth rate in the range $\omega_{Bi} < \omega < \omega_{Be}$. For hydrodynamic instabilities with growth range $\gamma \sim (\omega_{Be}\omega_{Bi})^{1/2}$ the oscillations are appreciably electromagnetic when the velocity u is of the order of the Alfvén velocity. In a plasma with hot ions and cold electrons $(T_i > T_e)$, when $u \gtrsim v_{Ti} \equiv (T_i/m_i)^{1/2}$ oscillations with the maximum growth rate are essentially electromagnetic when $\beta_i = B_e T_i/T_e \gtrsim 1$. (auth)

25776 ELECTROMAGNETIC INSTABILITIES IN A FINITE β PLASMA WITH HOT ELECTRONS. Egorenkov, V.D.; Stepanov, K.N. Sov. Phys.-Tech. Phys. 18: No. 2, 178-180 (Aug 1973).

The effect of a loss cone and the presence of a small group of cold electrons on the stability of a uniform anisotropic finite-β plasma containing hot electrons is studied. The loss cone attenuates the firehose instability and enhances the mirror instability; it also leads to the appearance of pure loss-cone instability. The instabilities are electromagnetic waves which correspond in an isotropic plasma to an Alfvén wave (unmagnetized ion sound), to a fast magnetoacoustic wave (whistler), and to a slow magnetoacoustic wave (magnetized ion sound).

The presence of a small group of cold electrons can change the spectrum and the stability conditions. (auth)

25777 STABILITY OF A PLASMA CYLINDER WITH COUNTERSTREAMING AXISYMMETRIC CURRENTS. Elfimov, A.G.; Nekrasov, F.M. Sov. Phys.-Tech. Phys. 18: No. 2, 157-160 (Aug 1973).

The equations of ideal magnetohydrodynamics are used to study the stability of a current-carrying plasma cylinder in a strong longitudinal magnetic field. The equilibrium distribution of the current is chosen in such a way that homogeneous currents flow in opposite directions in the interior and exterior regions of the cylinder, while the intermediate region is occupied by a current-free plasma. The stability problem is solved by the energy principle. The limits for stable and unstable perturbations are determined in the plane of the wave numbers n and m (n is the longitudinal wave number, m is the azimuthal wave number). The effect of the geometric parameters of the equilibrium plasma configuration on these limits is indicated. A configuration with currents in opposite directions has the advantage over one with a current in the same direction that it allows much greater ohmic heating for the same stability margin. (auth)

25778 SUPPRESSION OF THE FLUTE INSTABILITY IN A DENSE PLASMA IN AN OPEN SYSTEM BY MAGNETIC FEEDBACK. Arsenin, V.V. Sov. Phys.-Tech. Phys. 18: No. 2, 161-165 (Aug 1973).

The stabilization of flute instabilities in a dense plasma by a feedback system that senses the magnetic field of the perturbation outside the plasma is studied. The perturbations are described by the equations of magnetohydrodynamics. The model is a plasma cylinder of finite length with boundaries in a homogeneous magnetic field. The effect that slight inhomogeneity of the magnetic field has in real traps—it is the cause of the instability—is simulated by the introduction of a radial gravitational force. If the plasma is terminated at its ends by conducting planes, the stabilizing effect of the feedback reduces to increasing the phase velocity of the surface Alfvén waves. To stabilize flutes in a plasma with free ends, one must change the sign of the perturbation of the axial magnetic field beyond the lateral surface of the plasma, and the value of this perturbation must be greater than it is inside the plasma. The magnetic stabilization system can be realized in the form of orthogonal windings with variable winding density with negative resistance and negative inductance. Such coils have been used in experiments on the stabilization of a current-carrying plasma cylinder. (auth)

25779 FLUTE STABILITY IN A TOROIDAL PLASMA. Yashin, V.I. Sov. Phys.-Tech. Phys. 18: No. 2, 166-169 (Aug 1973).

The energy principle is used to obtain a necessary and sufficient condition for flute stability in the magnetohydrodynamic approximation. It is shown that a magnetic well and shear have stabilizing effects. (auth)

25780 STABILITY OF AN ELECTRON BEAM IN AN INHOMOGENEOUS DIELECTRIC MEDIUM. Buts, V.A. (Khar'kov Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR). Sov. Phys.-Tech. Phys. 18: No. 3, 293-298 (Sept 1973).

The stability of a uniform, unbounded electron beam, propagating through an inhomogeneous medium, is considered. It is shown that the transition radiation of the individual particles of the beam excites oscillations in the beam. The growth rate is proportional to the individual radiated power of these particles and to the beam density ω_b. The motion of a charged particle beam along a metal waveguide of radius a, filled by a periodic inhomogeneous plasma and located in a strong magnetic field ($\omega_H > \omega$, ω_b), is solved. Gain conditions for longitudinal and transverse waves are found. (auth)

25781 TIME BEHAVIOR OF PARAMETRIC INSTABILITIES IN INHOMOGENEOUS PLASMAS. Laval, G.; Pellat, R.; Pesme, D. (Ecole Polytechnique, Paris). Phys. Lett., 46A: No. 4, 281-282(31 Dec 1973).

Explicit time behavior of the solution of the parametric instability equations is given for a mismatching with a linear dependence upon space. (auth)

25782 NUMERICALLY DETERMINED INSTABILITY GROWTH RATES FOR A BELT PINCH. Appert, K.; Berger, D.; Gruber, R. (Centre de Recherches en Physique des Plasmas, Lausanne, Switzerland). Phys. Lett., 46A: No. 5, 339-340(14 Jan 1974).

A belt pinch experiment is approximated by a one-dimensional model in ideal MHD. The instability growth rates of the m = 1 and 2 modes are calculated by the method of finite elements. The growth rates depend strongly on the density of the residual gas near the walls of the device. (auth)

25783 MAGNETIC FIELD GENERATION IN AN INHOMOGENEOUS PLASMA. Al'tercop, B. A. (Inst. of High Temperature, Moscow); Mishin, E. V. Phys. Lett., 46A: No. 5, 319-320(14 Jan 1974).

The conditions of the convective instability of an inhomogeneous plasma resulting in strong magnetic field excitement are considered. The instability role in the problem of laser thermonuclear fusion is discussed. (auth)

25784 COLLISIONAL IMPURITY MODES. Coppi, B.; Schep, T. J. (Massachusetts Inst. of Tech., Cambridge). Phys. Lett., 46A: No. 5, 361-362(14 Jan 1974).

Fluid-like instabilities are shown to be excited, in a magnetically contained plasma, by the presence of a finite amount of impurity ions. The relevant modes have longitudinal wavelengths larger than the mean free path of the non-impurity ion population and are associated with their finite thermal conductivity. (auth)

25785 EQUILIBRIA AND STABILITIES OF z-PINCH IN MULTIPOLE MAGNETIC FIELDS. Nikulin, M. G. Zh. Prikl. Mekh. Tekh. Fiz.; No. 1, 23-29(1974). (In Russian).

Questions on the equilibria and stabilities of current-carrying plasma columns are examined with reference to kink perturbations in the general case of a multipole stabilizing field. The equilibrium form of the cross section of the plasma column with flow in a multipole magnetic field is found. The components of the forces acting on the perturbed column with the sides of the field are calculated. It is shown that the interaction of external fields with the flow in the column during perturbation occurs only for quadrupole fields. The results obtained are discussed in connection with problems of multipole dynamic stabilization of the z-pinch with respect to kink perturbations. (tr-auth)

25786 DECAY INSTABILITY OF CIRCULARLY POLARIZED WAVES INTO CIRCULARLY POLARIZED AND LANGMUIR WAVES IN A MAGNETIZED PLASMA. Lee, K. F. (Chinese Univ. of Hong Kong, Shatin). J. Plasma Phys.; 11: 99-109(Feb 1974).

A study was made of a parametric instability in a magnetized plasma in which an electromagnetic pump wave of either right- or left-hand circular polarization decayed into a Langmuir wave and another circularly polarized wave, all with wave vectors colinear with the external magnetic field. The analysis was based on a multiple-time-scale perturbation expansion of the fluid equations, incorporating the effects of temperature, collisions, and the spatial variation of the pump wave. The threshold values of the pump field intensity required for instability and the growth rates above threshold were calculated. (auth)

25787 EFFECTS OF NEUTRAL GAS FRICTION AND ION VISCOSITY ON THE RAYLEIGH-TAYLOR INSTABILITY OF A STRATIFIED PLASMA IN THE PRESENCE OF HALL CURRENTS. Bhatia, P. K. (Univ. of Jodhpur, India). J. Plasma Phys.; 11: 1-10(Feb 1974).

The effects of neutral gas friction, on the Rayleigh-Taylor instability of an infinitely conducting plasma of variable density, with ion viscosity and Hall currents, were investigated. For an ambient horizontal magnetic field, it was shown that the solution was characterized by a variational principle. Making use of the existence of this, proper solutions were obtained for a semi-infinite plasma, in which the density was stratified exponentially along the vertical, confined between two planes. In the simultaneous presence of the effects of ion viscosity and Hall currents, it was found that the potentially unstable stratification was unstable for all wavenumber perturbations, irrespective of whether or not the effects of neutral gas friction were included. Further, it was found that the growth rate increased with both Hall currents and neutral gas friction, and decreased with ion viscosity. The influence of the Hall currents and the neutral gas friction, therefore, was destabilizing, while that of ion viscosity was stabilizing. In the absence of Hall currents, it was found that the viscous plasma was stable, even for a potentially unstable stratification, for perturbations confined to a cone about the magnetic field vector. The angle of the cone of stable propagation of an inviscid plasma, however, decreased with both Hall currents and effects of neutral gas friction. (auth)

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Refer also to abstract 26137.

25788 (BNL-18439) MINIMUM ACTIVITY BLANKETS FOR COMMERCIAL AND EXPERIMENTAL POWER REACTORS. Powell, J. R.; Miles, F. T.; Aronson, A.; Winsche, W. E.; Bezler, P. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 25p. (CONF-731114-50). Dep. NTIS $3.25.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

A new kind of tritium breeding blanket for fusion reactors is investigated. All components in the blanket are solid, including the lithium containing material, which eliminates problems of corrosion and materials compatibility. This permits the use of structural materials with very low neutron activation. A promising structural material is SAP, a pure aluminum strengthened by an Al_2O_3 dispersoid. Three types of blanket module designs are investigated in which the helium coolant exit temperature is substantially greater than the maximum operating temperature of SAP (~400°C). Exit temperatures range from 500°C to above 1000°C, while breeding ratios range from 0.9 to 1.5, depending on design. Structural stress is ~2000 psi, which is ~20% of failure stress. The bred tritium diffuses from the lithium alloy or compound (e.g., LiAl), which has a much higher tritium pressure than pure lithium, into the helium coolant stream from which it is recovered. Depending on processing rates, temperature, LiAl inventory, and the amount of scavenging by added H_2, the tritium blanket inventory ranges from $\sim 10^5$ to 10^6 curies. Short lived activities, principally ^{24}Na (15 hour half life), decay to a negligible amount in a few days, leaving a long lived inventory of $\sim 10^4$ curies/1000 MW(e) [principally ^{26}Al (7.3×10^5 year half life)]. This material appears to present no problems of permanent waste disposal. Because of the very low inventory of long lived activities, blanket repair or replacement seems relatively simple. (auth)

25789 (CONF-740104-6) WALL CONDITIONS IN ORMAK. Colchin, R. J.; Berry, L. A.; Haste, G. R.; Kelley, G. G.; Lyon, J. F.; McNally, J. R.; Murakami, M.; Neidigh, R. V.; Simpkins, J. E.; Wing, W. R. (Oak Ridge National Lab., Tenn. (USA)). 1972. 10p. Dep. NTIS $3.00.

From surface effects in controlled thermonuclear fusion devices and reactors meeting; Argonne, Illinois, USA (10 Jan 1974).

ORMAK is a diffuse toroidal pinch with typical plasma currents of 100 kA, electron temperatures of 800 eV, and ion temperatures of 300 eV. The walls of the plasma region are made of stainless steel coated with an intermediate layer of platinum 0.05 μ thick and an outer 1 to 2 μ layer of gold. Tests with an Ion Microprobe Mass Analyzer have shown that the platinum acts to decrease diffusion of impurities from the stainless steel to the surface. Gold was chosen to inhibit the surface chemical adsorption of gases. Studies with a movable limiter indicate that electron energy is lost at the plasma edge mainly via line radiation and cooling on ions, while ions are lost from the plasma by charge exchange. Thus the walls are bombarded by energetic neutrals, line radiation and, in addition, bremsstrahlung x-rays. The flux of energetic neutrals is measured by a charge exchange analyzer. Wall bombardment by such neutrals should cause sputtering, and gold has been observed spectroscopically near the limiter, increasing with time during a shot. However, analysis of impurities coated on a window by the discharge indicated very little gold sputtering and re-deposition. To measure the sputtering rate, a wall sample was coated with 105 Å of radioactive gold and bombarded with neutrals from ORMAK during a day's run. No measurable sputtering was found within the counting statistics of the measurement, but surface carbon contamination of the sample prevented any final conclusions. (auth)

25790 (CONF-740104-8) CHEMICAL EFFECTS OF THERMONUCLEAR PLASMA INTERACTIONS WITH INSULATOR AND METAL SURFACES. Gruen, D. M. (Argonne National Lab., Ill. (USA)). 1973. 12p. NTIS $3.00.

From surface effects in controlled thermonuclear fusion devices and reactors meeting; Argonne, Illinois, USA (10 Jan 1974).

The interactions of chemically reactive ions with insulator and metal surfaces result in specific chemical effects which must be considered in sputtering, blistering, trapping and re-emission processes involving these projectiles. Chemical sputtering and chemical trapping of ion beam flux are examples of chemical interaction effects which are discussed. Bombardment of a niobium surface by oxygen and nitrogen ions results in the formation of sputtered niobium oxide and nitride molecules. The molecular species are identified and characterized by means of their vibrational spectra using isotopic substitution and matrix isolation techniques. Results using matrix isolation spectroscopy for both physical and chemical sputtering studies on materials of CTR interest are presented. Chemical trapping is evaluated as a method of chemically pumping the major fraction of the ion beam flux in the divertor of next generation Tokamaks. Suitable trapping surfaces, surface lifetimes, and reprocessing schemes are discussed on the basis of available information on trapping efficiencies and thermochemical data for a variety of metals. (auth)

25791 (CONF-740104-9) FLUXES OF CHARGED AND NEUTRAL PARTICLES FROM TOKAMAKS. Hogan, J. T.; Clarke, J. F. (Oak Ridge National Lab., Tenn. (USA)). 1973. 16p. Dep. NTIS $3.00.

From surface effects in controlled thermonuclear fusion devices and reactors meeting; Argonne, Illinois, USA (10 Jan 1974).

A brief description of a tokamak is given and some related impurity problems are discussed. The role of neutral particles and their influence on present and future experiments involving larger machines is described. Some experimental and theoretical data are shown. (MOW)

25792 (CONF-740213-1) ENVIRONMENTAL IMPACT OF FUSION POWER. Fraas, A. P. (Oak Ridge National Lab., Tenn. (USA)). 1973. 26p. Dep. NTIS $3.50.

From 140th meeting on the American Association for the Advancement of Science; San Francisco, California, USA (24 Feb 1974).

The environmental effects of fusion power is considered assuming as a typical model a conceptual design for a full-scale fusion power plant. The appraisal indicates that such a system would yield plentiful, cheap power for all of the world's energy requirements and provide fine solutions to most of the environmental pollution problems if the uncertainties in the plasma physics can be resolved in the fashion that current experiments lead one to expect. (auth)

25793 (CONF-740402-1) MAGNETOHYDRODYNAMIC BLANKET SCALING IN A TOROIDAL FUSION REACTOR. Young, F. J. (Oak Ridge National Lab., Tenn. (USA)). 1973. 17p. Dep. NTIS $3.00.

From topical meeting on technology of controlled nuclear fusion; San Diego, California, USA (16 Apr 1974).

The magnetohydrodynamic scaling of a full sized blanket is investigated with a view to specifying an experimental scale model blanket, the smaller the better, that will be magnetohydrodynamically similar to the lithium blanket of a full sized prototype reactor. The equations of magnetohydrodynamic channel flow and heat transfer were subjected to an inspectional analysis. Of all the possible dimensionless parameters describing MHD channel flow and heat transfer the most important were identified. For the present lithium blanket design they are given by: Reynolds number = 210,000, magnetic Reynolds number = 0.34 (in pumping region) and 11.34 (in field-flow aligned region), magnetic Mach number = 0.00425 (implying a Hartmann number of 63,000) and Peclet number = 4000. The properties of many liquid metals were studied as possible candidates for the scale model liquid. It was determined that either NaK 44 or NaK 78 can be used to obtain MHD similarity provided the fluids are heated to temperatures of 180°C and 135°C, respectively. If it is assumed that the magnetic field is supplied by a superconducting niobium-titanium magnet producing a field of 7.5 Tesla, the model scale factor for NaK 44 is 1/2.77 and for NaK 78, 1/2.58. Thus the model can be about one-third the size of the full scale lithium channel. (auth)

25794 (IFA-FR-114-1973) THERMONUCLEAR REACTOR, THE PLASMA OF WHICH IS CONTROLLED BY NUCLEAR FISSION. Cristea, G. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

A spherical reactor is proposed that uses a mixture of deuterium–tritium and enriched ^{235}U in the gaseous state. The reflector and moderator systems are described. The startup, control, and monitoring of the reactor are mentioned. Some of the working parameters of the reactor are outlined. (MOW)

25795 (INDC(NDS)-57-U + F) REQUEST LISTS OF NUCLEAR DATA FOR CONTROLLED FUSION RESEARCH AS SUBMITTED TO THE INTERNATIONAL ATOMIC ENERGY AGENCY BY MEMBER STATES. Lemley, J. R. (comp. and ed.). (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Dec 1973. 95p. Dep. NTIS (U. S. Sales Only) $6.75.

The International request list contains 260 requests from five member states: FRG, France, UK, USA, and USSR. With one exception all requests are for data associated with neutron-induced interactions. There are no requests for nuclear data associated with plasma interactions or charged-particle reactions. Except for a few requests for capture gamma-ray spectra all requests specify a maximum incident neutron energy of about 15 MeV. (MOW)

25796 (LA-5499-MS) SCALING LAWS FOR THE LINEAR THETA PINCH. II. Circulating Power in a High-Field Reactor. Ellis, W. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 16p. Dep. NTIS $4.00.

The dc joule losses per unit length in a theta-pinch compression coil are calculated and compared to the thermonuclear energy production for two different methods of plasma heating. In the first method, conventional staged theta-pinch heating is assumed. In the second method, laser heating by long wavelength irradiation from the ends is assumed. Reactor parameters are calculated, and it is shown that for circulating power fractions to be 20% or less, the plasma radius must be at least a few cm in size. (auth)

25797 (LA-UR-73-1684) FUSION REACTORS AS FUTURE ENERGY SOURCES. Post, R. F.; Ribe, F. L. (Los Alamos

Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 35p. (CONF-731208-1). Dep. NTIS $3.75.

From conference on energy policies and the international system; New Delhi, India (4 Dec 1973).

The need is now apparent for a global energy policy with the following characteristics: Compatibility with environmental and economic factors; large fuel resources, the recovery and exploration of which have minimal environmental impact and which do not introduce disturbing factors into the world political situation. Fusion power in this context is discussed, including assessments of its potential and of the problems yet to be solved in achieving its realization. The proposition is advanced that fusion should be considered as the ultimate source of energy, and that other sources of energy, including conventional nuclear power, should be considered as interim sources. (auth)

25798 (LA-UR-74-42) SURFACE EFFECTS AT THE FIRST-WALL OF THE REFERENCE THETA-PINCH REACTOR (RTPR). Krakowski, R. A.; Clinard, F. W. Jr.; Ribe, F. L.; Coultas, T. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 11p. (CONF-740104-10). Dep. NTIS $3.00.

From surface effects in controlled thermonuclear fusion devices and reactors meeting; Argonne, Illinois, USA (10 Jan 1974).

The fundamental operating principles and parameters inherent to the Reference Theta-Pinch Reactor (RTPR) are described herein. An emphasis is placed on those engineering aspects of the RTPR design which bear directly on the thermal, hydraulic, and radiation response of the first wall. The major portion of the data presented is calculational, and further experimental and theoretical results are needed to assess accurately anticipated material problems and to forecast appropriate solutions. Material problems envisioned for the RTPR first wall are discussed briefly in the context of the particular RTPR design described. (auth)

25799 (LA-UR-74-43) MONTE CARLO TREATMENT OF HEAT FLOW THROUGH A NEUTRAL GAS LAYER. Oliphant, T. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 7p. (CONF-740104-17). Dep. NTIS $3.00.

From surface effects in controlled thermonuclear fusion devices and reactors meeting; Argonne, Illinois, USA (10 Jan 1974).

The flow of heat through a neutral gas layer under conditions of density and temperature relevant to the cooling layer used in a reference theta-pinch reactor (RTPR) was investigated numerically by means of a Monte Carlo technique. The necessity for corrections to the fluid model was indicated and assessed in an example calculation. (auth)

25800 (LA-UR-74-56) FIRST WALL FLUXES IN A THETA PINCH FEASIBILITY/D-T EXPERIMENT. Thomassen, K. I.; Oliphant, T. A. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 10p. (CONF-740104-18). Dep. NTIS $3.00.

From surface effects in controlled thermonuclear fusion devices and reactors meeting; Argonne, Illinois, USA (10 Jan 1974).

The Physics Test Reactor (PTR) which will be designed to first demonstrate scientific feasibility and later be converted to handle tritium for D-T burning experiments is briefly discussed. First wall flux calculations are described that considered the implosion heating physics and a thermonuclear burn calculation specifying the time history of neutron and bremsstrahlung production and plasma internal energy. (MOW)

25801 (LA-UR-74-61) PROJECT MANAGEMENT OF SCYLLAC CONSTRUCTION. Harris, H. W.; Kemp, E. L.; Quinn, W. E.; Ribe, F. L. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 8p. (CONF-731114-47). Dep. NTIS $3.00.

From fifth symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

Scyllac, a 10-MJ (~$10 million) toroidal theta-pinch experiment, was authorized by Congress in 1968 and the first plasma experiments began in 1971. The procedures used to establish and maintain communication between the physicists, the engineers and the installation personnel in the design and construction of the experiment are described. (auth)

25802 (LA-UR-74-71) STUDY OF CAPACITIVE ENERGY STORAGE FOR A THETA-PINCH PTR COMPRESSION COIL. Kemp, E. L. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 8p. (CONF-731114-49). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

The present Los Alamos theta-pinch experiments shock heat and compress the plasma with a single high-voltage, low-inductance capacitor bank. The Los Alamos theta-pinch physics test reactor experiment (PTR) will use independent energy systems to perform these two functions. The implosion-heating coil will be driven by a number of high-voltage (125 kV) pulse-forming networks in series around the coil. The compression coil will be driven by a relatively slow rising current from a magnetic energy transfer system (METS) or a low-voltage capacitor bank. A study of a low-voltage (10 kV), low-cost capacitor bank to drive the compression coil is presented. The experiment under consideration has a 30-m major radius with a 16-cm bore and requires a maximum compression field of 60 kG. The total energy in the compression storage system is about 300 MJ. The capacitor bank being considered will store 150 MJ. The development program for the capacitors and switches is described. The system considerations are presented and a table of costs is given. (auth)

25803 (ORNL-TM-4501) MAGNETIC ISLAND FORMATION IN A TOKAMAK PLASMA FROM HELICAL PERTURBATIONS OF THE PLASMA CURRENT. Chrisman, P.; Clarke, J.; Rome, J. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 20p. Dep. NTIS $3.00.

The formation, structure, and some of the consequences of magnetic islands in a tokamak plasma are discussed. These may be produced from helical current perturbations in the plasma. The existence, structure, and magnitude of the current perturbations causing the island formation is deduced from experimental measurements of the time rate of change of the poloidal magnetic field in the ORMAK device. (MOW)

25804 (UCID-16429) EXPERIMENTAL RESULTS ON THE TWO-STAGE, VENETIAN BLIND, DIRECT ENERGY CONVERTER. Moir, R. W.; Barr, W. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Feb 1974. Contract W-7405-eng-48. 25p. Dep. NTIS $3.25.

Some preliminary results obtained from experiments designed to test the feasibility of the Venetian Blind, direct energy-conversion concept are discussed. A two-stage unit was built and tested and found to have an overall efficiency of 65% for an energy spread of from 330 to 1000 eV. The calculated efficiency was 69% leaving a 4% discrepancy. This discrepancy seems to result from the slight transparency in the backward direction of the ribbons of the converter. (auth)

25805 (UCRL-75281) SURFACE CONDITIONS IN A CONCEPTUAL D−T MIRROR REACTOR WITH DIRECT CONVERSION. Lee, J. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Jan 1974. 13p. (CONF-740104-12). Dep. NTIS $3.00.

From surface effects in controlled thermonuclear fusion devices and reactors meeting; Argonne, Illinois, USA (10 Jan 1974).

A conceptual D−T fusion reactor employing magnetic mirror confinement and periodic focusing electrostatic direct conversion is described with emphasis on surface conditions. (auth)

25806 (UCRL-75323) SURFACE REQUIREMENTS FOR ELECTROSTATIC DIRECT ENERGY CONVERTERS. Moir, R. W.; Barr, W. L.; Miley, G. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.; Illinois Univ., Urbana (USA)). 17 Jan 1974. 18p. (CONF-740104-14). Dep. NTIS $3.00.

From surface effects in controlled thermonuclear fusion devices and reactors meeting; Argonne, Illinois, USA (10 Jan 1974).

There are two major electrostatic direct energy converter concepts which will be discussed from the point of view of the surfaces. One is the Venetian blind concept and the other is the periodic electrostatic focusing concept. They are both of the direct collector type. Fluxes of D^+, T^+, He^{++}, electrons, and x-rays are given. Design consideration due to thermionic emission, secondary electron emission, and radiation cooling are discussed. A detailed discussion is devoted to breakdown physics, the voltages and electric field strengths that can be employed, and how surface deterioration may affect voltage holding due to He^{++} bombardment blistering. (auth)

25807 (UCRL-75324) PHYSICS OF MIRROR REACTORS AND DEVICES. Moir, R. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Jan 1974. 13p. (CONF-740104-15). Dep. NTIS $3.00.

From surface effects in controlled thermonuclear fusion devices and reactors meeting; Argonne, Illinois, USA (10 Jan 1974).

The physics of plasma confinement using the magnetic mirror principle is discussed, and the unique features of the mirror reactor approach to fusion are discussed and compared to the toroidal confinement approach. (auth)

25808 DRIVE ELECTROSTATIC PLASMA OSCILLATIONS IN A CLOSED ELECTRON DRIFT ACCELERATOR. Morozov, A.I.; Nevrovskii, V.A.; Smirnov, V.A. Sov. Phys.-Tech. Phys. 18: No. 3, 339-343 (Sept 1973).

The present work describes and experimental investigation of the perturbations created in the plasma of a closed electron drift accelerator

(CEDA) by a time-varying potential applied to an electrode in the plasma. In particular, the driven electrostatic oscillations are in phase over the entire volume of the channel and the attenuation of the signal amplitude is sensitive to the direction of the electron flux in the accelerator. Certain aspects of the propagation of the harmonic signals and pulses in the plasma are established. A substantial drop in signal amplitude occurs between the electrode and the plasma. (auth)

25809 EFFECT OF A FEEDBACK SYSTEM ON THE PLASMA FLUX IN AN ACCELERATOR WITH CLOSED ELECTRON DRIFT. Morozov, A.I.; Nevrovskii, V.A.; Smirnov, V.A. Sov. Phys.-Tech. Phys. 18: No. 3, 344-347 (Sept 1973).

The paper describes experiments involving the excitation and stabilization of electrostatic perturbations of the plasma in an accelerator with closed electron drift and an extended ion acceleration zone (ACED, also known as a linear Hall generator); a control system consisting of a sensor probe, a bandpass filter, a delay line, and amplifier, and a control electrode in the plasma is used. The control electrode controls the electron density in the plasma and results in stabilization or excitation of electrostatic perturbations in the channel depending on the signal delay in the control system. Certain features of the operation of the control system associated with the turbulent nature of the plasma perturbations have been discovered. (auth)

25810 GENERATION OF MEGAGAUSS MAGNETIC FIELDS USING A LINER COMPRESSED BY HIGH-PRESSURE GAS. Velikhov, E.P.; Vedenov, A.A.; Bogdanets, A.D.; Golubev, V.S.; Kasharskii, E.G.; Kiselev, A.A.; Rutberg, F.G.; Chernukha, V.V. Sov. Phys.-Tech. Phys. 18: No. 2, 274-279 (Aug 1973).

The design of a device for generating pulsed megagauss fields in a large volume is described. The magnetic field is amplified by adiabatic compression in a cylindrical metal shell imploded by high-pressure gas ($1-2\cdot10^3$ atm). The design energy in the compressed magnetic field is several megajoules and the lifetime is tens of microseconds. Unlike devices that use explosives, the present device is not destroyed. Unlike devices that use the energy of an electromagnetic field to compress a liner, the problem of storing and switching very large amounts of electromagnetic energy does not arise. (auth)

25811 CHEMICAL LASERS. Chester, A. N. (Hughes Research Labs., Malibu, CA). Energ. Nucl. (Milan); 21: No. 1, 23-49(Jan 1974).

The definition of a chemical laser is given, and it is explained how chemical reactions lead to inverted populations. The basic types of chemical lasers are described, in terms of their internal mechanisms, their output characteristics, and their technology. Typical devices are presented and areas of current research interest are pointed out. The state of current theoretical modeling is summarized for the most important laser types. Some general considerations are given relating to the generation of short pulses and short wavelengths from chemical lasers, and the implications of these considerations with regard to current research directions are explored. (auth)

25812 WHEN WILL NUCLEAR FUSION PLANTS BE AVAILABLE TO THE POWER INDUSTRY. Present Situation and Development Trends. Knobloch, A. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). VGB Kraftwerkstechnik; 53: No. 11, 707-716(Oct 1973). (In German).

Nuclear fusion power plants are one of the future sources of energy to be seriously envisaged. In spite of many unanswered questions, there is no longer any doubt today that the fusion reactor as an energy supplier may be less of a competitor and more of an urgently needed partner and successor to the fast breeder reactor after the year 2000. (GE)

25813 MEASUREMENT OF WALL HANGUP TIME FOR THE LINEAR PINCHED DISCHARGE. Wheeler, C. B. (Imperial Coll. of Science and Tech., London). J. Phys., D (London); 7: No. 2, 363-368(21 Jan 1974).

Measurements were carried out on a slow linear pinch in argon using rates of current rise $\dot{I}$ between 10^8 and 10^{10} A s^{-1}. Determination of the wall hang-up time t_w by comparison of the measured time to pinch with theoretical collapse models gave values that strongly disagreed with estimates obtained from image converter observation. However, the duration of the initial plateau in the tube voltage waveform yielded values of t_w that were in excellent agreement with values obtained from magnetic probe data. These measurements gave the dependence $t_w \propto \dot{I}^{-0\cdot66}$, which was weaker than the dependences predicted by theories based on neutral depletion ($\dot{I}^{-1/2}$), pressure balance ($\dot{I}^{-1}$), magnetically reduced conductivity ($\dot{I}^{-1}$) and wall evaporation ($\dot{I}^{-2}$). Moreover, all of these theories gave numerical values of t_w that were very different from the measured times. (auth)

25814 TWO FUSION REACTOR BLANKETS WITH VANADIUM AS STRUCTURAL MATERIAL. Struve, J. E.; Tsoulfanidis, N. (Univ. of Missouri, Rolla). Nucl. Technol.; 21: No. 3, 201-207 (Mar 1974).

Calculations of the tritium breeding ratio and heating rates for two proposed blanket designs are obtained by using the Monte Carlo method. The materials used for the blanket are vanadium and lithium. Lithium is used to slow down the neutrons and produce tritium by the ^{6}Li(n,T)^{4}He and ^{7}Li(n,n′,T)^{4}He reactions. Vanadium is used as the structural material. Results obtained indicate that a tritium breeding ratio of 1.3 is easily obtained by either design and that the heating rates for both designs are similar. These results are in general agreement with previous studies of fusion reactor blankets which used niobium as the structural material. (auth)

25815 FUSION POWER: TYPES, STATUS, OUTLOOK. Dean, S. O. Power Eng.; 78: No. 3, 46-49(Mar 1974).

A general review of the fusion program is given. Earlier research is briefly discussed. The tokamak concept and some of its results are outlined along with future areas of research. (MOW)

25816 FUSION POWER: HALLMARK OF THE 21st CENTURY. Landis, J. W. (Gulf General Atomic Co., San Diego, CA). J. Chem. Educ.; 50: No. 10, 658-662(Oct 1973).

The advantages and disadvantages of fusion and fission energy sources are briefly outlined. The actual conversion process of fusion energy into electrical energy is discussed. The Doublet devices at Gulf General Atomic are discussed in particular. (MOW)

25817 HYDROGEN ROTATION-VIBRATION OSCILLATOR. Rhodes, C. K. (to United States Atomic Energy Commission). US Patent 3,789,319. 29 Jan 1974. Filed Date 8 May 1972. 6p.

A laser system is described wherein molecular species of hydrogen and hydrogen isotopes are induced to oscillate on rotational-vibrational levels by subjecting the hydrogen to a transverse beam of electrons of a narrowly defined energy between about 1 and 5 eV, thereby producing high intensity and high energy output. (Official Gazette)

25818 APPARATUS FOR INITIATING DEUTERIUM-TRITIUM FUSION. Pedrick, A. P. British Patent 1,337,936. 21 Nov 1973. Filed date 24 Jul 1972. 4p.

Apparatus is described for initiation of a nuclear fusion reaction between D and T, in a controlled manner. It comprises a cylindrical shell made of steel, or some other suitable material, having a high gloss on its bore, into which may be injected streams of radiant energy from a laser device. The laser beams are directed at, or very close to, the main axis of the shell. Three or more gun barrels are directed radially at the center of the shell with explosive charges at their outer ends, the simultaneous ignition of which project high speed bullets having recessed noses containing D and T inserts. The bullets are governed to pass through the shell at approximately the same speed by speed sensing contact rings linked, in a control unit, to magnetic coil braking fields. The control unit also operates to delay simultaneous firing of the laser device until the bullets are close to simultaneous impact at the center of the shell, so as to avoid as far as possible wastage of energy from the laser beams by reflection at the surface of the shell bore. The apparatus is thus arranged so as, when three or more bullets are in simultaneous impact at the center of the shell, to enclose a small approximately spherical space containing a high intensity of radiant energy, in a shell of D and T, which will take part in a nuclear fusion reaction at the high temperature attained within the small enclosed space. (UK)

25819 IMPROVEMENTS IN OR RELATING TO LASERS. Varey, R. H.; Andrews, J. G. (to Central Electricity Generating Board). British Patent 1,338,217. 21 Nov 1973. Filed date 11 Aug 1969. 4p.

Apparatus is described for producing and utilizing electrons in a selected energy range, employing a new type of laser. The laser described comprises a gas discharge device containing an anode and a cathode, together with at least one apertured structure in the discharge path so as to produce a "double sheath" and "plasma sac," together with a pair of mirrors for forming a laser beam through the "plasma sac," the beam being formed by excitation of atoms by the high energy electrons in the "plasma sac." The anode and cathode may be cylindrical, and the mirrors arranged so that the laser beam passes through the anode and cathode. The gas discharge device may comprise a tubular container, with Brewster windows in the container wall, with the mirrors outside the container. The "double sheath" consists of a double space charge layer formed at the junction between two plasmas (see Proc. Roy. Soc. Lond.; A320: 459(1971)), and contains a voltage step such that the force exerted on electrons is in the opposite direction to that on the ions. The total voltage drop across the "double sheath" depends on the plasma conditions on either side and the electrons gain energy as they cross the boundary from the cathode to the anode side. Ways of creating the difference between the two plasma conditions required to produce the "double sheath" are described, including the introduction into the gas discharge column of a constriction in the form of an apertured structure extending across the electron path between cathode and anode. The "double sheath" developed over the cathode side of the constriction controls the flow of electrons and ions through the constriction, and the electric field inside the "double sheath" accelerates electrons from the cathode plasma into a "plasma sac," which is a light blob of plasma protruding out of the constriction into the cathode section of the gas discharge device. Ions from the "plasma sac" are accelerated in the opposite direction, from the "plasma sac" into the cathode plasma. By using this arrangement to accelerate electrons it is possible to produce electrons in a selected energy range with a very high flux. This arrangement is used to provide electrons in a selected energy range to form a laser, the electrons being used for the excitation of atoms to the appropriate energy level to provide laser action, and it is possible using this technique to obtain a laser with high electrical efficiency. Such lasers work at a power level far above the powers of present lasers. The electron flux energy produces light energy from a radiation-producing excitation-relaxation reaction, this light energy being built up by the laser action with multiple reflection between the mirrors. (UK)

Wave Phenomena

Refer also to abstract 25710.

25820 (AD-763736) NONLINEAR WAVE OPTICS OF PARAMETRIC PUMP RADIATION IN A INHOMOGENEOUS PLASMA. DuBois, D. F.; Goldman, M. V.; McKinnis, D. (Colorado Univ., Boulder (USA). Dept. of Astro-Geophysics). Mar 1973. 52p. (CU-1004; AFOSR-TR-73-1135). NTIS $4.75.

The self-consistent propagation of an intense (pump) beam that excites a parametric decay instability is calculated for an inhomogeneous plasma. The nonlinear absorptive conductivity calculated according to several recent theories for the saturated electron ion-decay instability in a homogeneous plasma is generalized for inhomogeneous plasmas. Saturation of the nonlinear conductivity for strong pumping is taken into account. This model of the nonlinear absorption is added to the linear absorption, and the authors carry out the numerical solution of the resulting nonlinear wave equation for radiation propagating into a plane-layered inhomogeneous plasma. Application is made to the anomalous absorption of the modifier radiation in ionospheric modification experiments and to absorption of laser radiation in laser-produced plasmas. (GRA)

25821 (AD-763744) LINEAR AND NONLINEAR WAVE-PARTICLE CYCLOTRON INTERACTION FOR WHISTLER-MODE WAVES IN AN ANISOTROPIC PLASMA. Newman, C. E. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Jun 1973. Contract N00014-67-A-0112-0062. 27p. (SU-IPR-523). NTIS $3.00.

The temporal behavior of a large-amplitude whistler mode was analyzed in an anisotropic plasma. The nonlinear equation is solved for the wave amplitude as a function of time. It is found that, in the $t \rightarrow 0+$ limit, the solution reproduces the linear theory. In the $t \rightarrow \infty$ limit one finds that the amplitude approaches a limiting value, i.e., saturation sets in. Arguments are then given for the existence of frequency bands for which the linear growth rate and the nonlinear value of the saturated logarithmic decrement are of opposite sign. This means that for these frequencies, the linear and nonlinear theory are in conflict in their predictions of ultimate growth or damping of the wave. The reasons for and implications of this phenomenon are discussed, and a comparison with nonlinear electrostatic modes is made. (auth)

25822 (COO-3237-33) RAMAN AND BRILLOUIN SCATTERINGS OF ELECTROMAGNETIC WAVES IN INHOMOGENEOUS PLASMAS. Liu, C. S.; Rosenbluth, M. N.; White, R. B. (Institute for Advanced Study, Princeton, N. J. (USA)). 1973. 36p. Dep. NTIS $4.00.

Raman and Brillouin scattering of an electromagnetic wave in an inhomogeneous, expanding plasma were studied. Application to laser-pellet irradiation is considered. (auth)

25823 (CNAEM-R-109) BEAM-PLASMA INTERACTION AND PLASMA WAVES IN AN ELECTRON BEAM-PLASMA SYSTEM. Gueltekin, E. (Cekmece Nuclear Research Center, Istanbul (Turkey)). 1973. 38p. Dep. NTIS (U. S. Sales Only) $4.00.

In an electron beam-plasma system, the dispersion diagram of the plasma wave was determined by means of an interferometer method. The relation between the phase velocity of the plasma instability and the beam velocity was measured. The plasma instability was studied as a function of different parameters. The plasma density was measured with a Langmuir probe and obtained from the dispersion characteristics of the plasma. The axial profile of the plasma temperature, plasma potential, and the density was also measured. (auth)

25824 (SLA-73-1116) SCATTERING OF AN ELECTROMAGNETIC WAVE BY AN INHOMOGENEOUS TURBULENT PLASMA. Brown, W. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1974. Contract AT(29-1)-789. 46p. Dep. NTIS $4.50.

A Born-eikonal formalism describing the scattering of an electromagnetic wave by an inhomogeneous turbulent plasma with a spacially varying electron collision frequency is described. The ensemble averaged properties of the plasma are taken into account in an eikonal approximation, while the fluctuating properties are treated by use of a perturbation series in which eikonal Green's functions describe the propagation between successive scatterings. A partial summation method which sums a larger class of perturbation terms than does the usual ladder (bilocal) approximation is suggested. This method is referred to as the uncrossed correlation line approximation in that all diagrams with correlation lines which do not cross are summed. The conditions under which the Bethe-Salpeter equation for the two-point correlation of the electric field reduces to the transport equation are discussed. In order to illustrate numerically some of the formal considerations discussed in this report, the backscattering of microwaves by a random plasma slab was computed for a variety of values of the parameters characterizing the plasma and the microwaves. For almost all of the values of the parameters for which the calculations were performed, the predictions of the Born-eikonal formulation to lowest order in the perturbation expansion were closer to the exact results than were the predictions of the Born approximation. The predictions of the Born-eikonal series to fourth order in the electron density fluctuations were usually closer to the exact results than were the lowest order Born-eikonal predictions. Transport equation results were in close agreement with the exact results when the plasma was underdense and not strongly absorbing. For an overdense or a strongly absorbing plasma, the transport equation yielded meaningless results such as negative scattering cross sections. (auth)

25825 ABSORPTION OF SUPERHIGH FREQUENCY RADIATION IN COLLISIONLESS PLASMA ISOLATED FROM THE WALLS OF THE WAVE GUIDE. Barinov, V. I.; Gekker, I. R.; Ivanov, V. A. Kratk. Soobshch. Fiz.; No. 9, 7-12(Sep 1973). (In Russian).

Measurements are made of the absorption of intense H (II) waves in columns of collisionless plasma isolated from the walls of the circular waveguide. It is shown that the presence of abnormally strong absorption of the waves in a dense plasma ($n/n_0 \sim 1$) due to the development of parametric instabilities of the plasma is connected neither with processes of linear transformation of the transverse waves in the longitudinal direction nor with the effect of secondary-emission superhigh frequency discharge with the walls. (tr-auth)

25826 SUPER-ALFVEN RAREFACTION WAVE IN A PLASMA. Altyntsev, A. T.; Koshilev, N. A.; Krasov, V. I.; Maslov, V. L.; Parfenov, O. G.; Shishko, A. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Novosibirsk, USSR). JETP Lett. (USSR) (Engl. Transl.); 18: No. 7, 233-235(5 Oct 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 7, 397-400(5 Oct 1973).

A super-Alfven rarefaction wave was seen to propagate in a magnetized plasma with $\beta \ll 1$ in a direction transverse to the magnetic field. At $\omega_{He}/\omega_{pi} \simeq 3 \times 10^{-2}$, the velocity of the wave reaches (10 to 30)v_A. The anomalously low conductivity σ points to a turbulent character of the processes in the wave front, where the penetration of the field has a diffuse character. (auth)

25827 PARAMAGNETIC EXCITATION OF ION-CYCLOTRON AND ION-ACOUSTIC WAVES IN A PLASMA WITH AN ALTERNATING ELECTRIC FIELD UNDER CONDITIONS OF THE LOWER HYBRID RESONANCE. Farenik, V. I.; Vlasov, V. V.; Rozhkov, A. M. (Kharkov State Univ.). JETP Lett. (USSR) (Engl. Transl.); 18: No. 7, 240-242(5 Oct 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 7, 409-413(5 Oct 1973).

Experiments are described that have revealed paramagnetic excitation of ion-cyclotron and ion-acoustic oscillations of a plasma situated in an alternating electric field of frequency ω_0 close to the lower hybrid resonance frequency $\omega_{LH} = \omega_{pi}(1 + \omega_{pe}^2/\omega_{He}^2)^{-1/2}$. (auth)

25828 RESONANT INTERACTION OF WAVE PACKETS IN NONLINEAR MEDIA. Zakharov, V. E.; Manakov, S. V. (Inst. of Nuclear Physics, Novosibirsk, USSR). JETP Lett. (USSR) (Engl. Transl.); 18: No. 7, 243-245(5 Oct 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 7, 413-417(5 Oct 1973).

The equations for the two types of resonant interactions (decay and explosive) are given. The case for monochromatic waves is considered. The method of the inverse scattering problem was used to integrate certain nonlinear operators without assuming the nonlinearity to be small. Solutions are given for monochromatic waves and the decay case for resonant interactions. (MOW)

25829 SPECTRUM OF LOW-FREQUENCY SURFACE WAVES EXCITED BY BEAMS IN CONFINED PLASMA. Kutsenko, V. A.; Loladze, V. D.; Rukhadze, A. A. Kratk. Soobshch. Fiz.; No. 9, 19-22(Sep 1973). (In Russian).

Unstable surface waves in an unmagnetized plasma cylinder mixed in a metallic waveguide are examined. The dependence of the oscillation frequency on the ratio of the waveguide radius to the plasma radius is determined. (tr-auth)

25830 PARAMETRIC EXCITATION OF SURFACE WAVES IN A BOUNDED INHOMOGENEOUS PLASMA. Aliev, Y.M.; Gradov, O.M. (M. V. Lomonosov Moscow State University). Sov. Phys.-Tech. Phys. 18: No. 2, 280-281 (Aug 1973).

The parametric interaction of nonelectrostatic surface and longitudinal ion-acoustic oscillations in an inhomogeneous plasma sheath in a high-frequency electric field is investigated. A dispersion relation is given for high-frequency surface waves which are not fully electrostatic. The threshold value of the rf field and the growth rate beyond the threshold are determined. (auth)

25831 STRUCTURE OF THE CURRENT FRONT OF AN ELECTRON-ACOUSTIC WAVE IN A PLASMA. Aref'ev, V.I. Sov. Phys.-Tech. Phys. 18: No. 3, 289-292 (Sept 1973).

The structure of the current front of an electron-acoustic shock wave propagating in a rarefied plasma in a direction almost transverse to the magnetic field, tan $\theta \simeq (m/M)^{1/2}$, is investigated. It is assumed that ionization collisions of electrons with neutral atoms constitute the main dissipative process responsible for damping of a nonlinear electron-acoustic wave and the formation of a shock wave. This situation occurs experimentally in discharges with a strong transverse magnetic field. Due to approximately uniform ionization in the sheath an effective ion-velocity spread occurs, which can be associated with the onset of an average temperature equal in order of magnitude to the applied potential difference, $T_i \simeq e\phi_0$. Under these conditions ions can be regarded as "hot," and electrons as "cold": $T_i > T_e$. The periodic structure of the front of a nonlinear electron-acoustic wave, damped as a result of ionization collisions, is derived and analyzed. The characteristic scale of the electrostatic oscillations, called the dispersion scale, is equal to the Larmor electron radius calculated from the ion temperature. When dissipation is considered, the periodic structure is damped, and under certain conditions a "collisionless electron-acoustic shock wave" is formed whose front has a width much smaller than the particle mean free path. (auth)

25832 REFLECTION OF ELECTROMAGNETIC WAVES FROM A MOVING PLASMA. Miroshnichenko, V.I. (Physicotechnical Institute, Academy of Sciences of the Ukrainian SSR, Khar'kov). Sov. Phys.-Tech. Phys. 18: No. 3, 299-303 (Sept 1973).

A kinetic theory is developed to treat the reflection of an extraordinary electromagnetic wave from a semiinfinite moving plasma in a constant homogeneous magnetic field H which is perpendicular to the plasma boundary. It is assumed that the incident wave is slowed down by a second plasma that fills the entire space. The effect of frequency dispersion of the permittivity of this second plasma on the reflection of the electromagnetic wave is studied. The general form of the field that penetrates into the plasma is determined allowing for the thermal motion of the electrons. The coefficient of reflection of the electromagnetic wave from the plasma half-space is calculated for the general case. The limiting cases of weak and strong spatial dispersion are studied. (auth)

25833 IONIZATION OSCILLATIONS IN A PLASMA WITH NEGATIVE IONS. Alanakyan, Y.R.; Vainer, B.V. (Research Institute for Physicotechnical and Radio Measurements, Moscow Region, Mendeleevo). Sov. Phys.-Tech. Phys. 18: No. 4, 441-447 (Oct 1973).

It is shown that negative ions in a plasma can cause an instability. Expressions are obtained for the frequency and growth rate of the ionization oscillations in a plasma with negative ions. Dense plasmas and rarefied plasmas are investigated. (auth)

25834 ELECTROMAGNETIC RADIATION FROM SURFACE PLASMA WAVES EXCITED BY A RELATIVISTIC ELECTRON BEAM. Aronov, B.I.; Bogdankevich, L.S.; Rukhadze, A.A. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. Phys.-Tech. Phys. 18: No. 4, 452-455 (Oct 1973).

The excitation of surface electromagnetic waves by a relativistic electron beam in a bounded plasma is analyzed. It is shown that quasielectrostatic surface waves are excited for $u \ll c$, i.e., in the case of a nonrelativistic beam; for a relativistic beam ($u \sim c$), the surface waves excited by the beam are strongly electromagnetic. The Poynting vector characterizing radiation from a bounded plasma is computed. The amplitude of steady-state waves in this case is estimated from the trapping of beam electrons in the potential well of the wave field. (auth)

25835 ANOMALOUS MICROWAVE ABSORPTION AT THE UPPER HYBRID FREQUENCY. Anisimov, A.I.; Vinogradov, N.I.; Poloskin, B.P. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.-Tech. Phys. 18: No. 4, 459-460 (Oct 1973).

Microwave absorption in a plasma in a toroidal chamber is investigated. It is established that the wave absorption is localized near the values of the plasma density and magnetic field corresponding to the hybrid resonance. The dimensions of the absorption region do not depend on the pressure of the neutral gas. Low frequency oscillations, apparently ion-acoustic waves, are observed in the absorption region. It is concluded that the absorption is due to a parametric instability. (auth)

25836 NONLINEAR ION-ACOUSTIC AND ELECTRON-ACOUSTIC WAVES IN A MAGNETOPLASMA. Pokroev, A.G.; Stepanov, K.N. (A. M. Gor'kii State University, Khar'kov). Sov. Phys.-Tech. Phys. 18: No. 4, 461-465 (Oct 1973).

Weakly nonlinear fast and slow ion-acoustic waves in a nonisothermal plasma with hot electrons and cold ions are treated in a magnetic field; electron-acoustic waves in a plasma with hot ions and cold electrons are also treated in a range of frequencies where the dispersion of these waves is nearly linear. It is shown that the potential of the slow ion- and electron-acoustic waves is determined by the Korteveg-de Vries equation, while the potential of the fast ion-acoustic wave is determined by an equation which differs significantly from the Korteveg-de Vries equation if the ion plasma frequency is significantly larger than the ion cyclotron frequency. (auth)

25837 EXCITATION OF ELECTRON-CYCLOTRON WAVES BY HIGH-CURRENT COUNTER-STREAMING ELECTRON BEAMS. Iremashvili, D.V.; Timoshenko, A.P.; Udovichenko, Y.K. Sov. Phys.-Tech. Phys. 18: No. 3, 348-351 (Sept 1973).

An experimental investigation is described of the interaction between counter-streaming electron beams in a homogeneous magnetic field of 250-700 Oe when the plasma and cyclotron frequencies are comparable ($\omega_p \gtrsim \omega_H$), as are the transverse and longitudinal velocities ($v_\perp \sim v_z$). The injected and cross beams are spatially varying (the beam being injected into the interaction chamber through an inhomogeneous magnetic field), and characteristic lengths are equal. At pressures $p < 3.10^{-4}$ mm Hg, for which beam-plasma discharge does not develop, intense oscillations are excited at half the cyclotron frequency and its harmonics. Maximum amplitude of these oscillations is observed at $p = 1.5 \cdot 10^{-4}$ mm Hg. Standing waves form along the interaction chamber; the half-wavelength of the fundamental coincides with the characteristic lengths. The experimental value of the wavelength at $\omega_H/2$ (as a function of magnetic field) is in good agreement with the theoretical value. The conditions for optimum excitation are obtained. When the current is varied in the range 0.2-1.2Å, there is a marked change in the intensity and half-width of the oscillation spectrum at $\omega_H/2$ and its harmonics. The amplitude of the oscillation increases with the magnetic field, this being a result of the fact that the growth rate depends on $v_z/v_\perp$ and ω_p. (auth)

25838 HYDRODYNAMIC THEORY OF LARGE-AMPLITUDE IONIZATION WAVES. Gorelik, M.S.; Tsendin, L.D. (Leningrad State University). Sov. Phys.-Tech. Phys. 18: No. 4, 478-481 (Oct 1973).

Ionization waves (striations) of finite amplitude are investigated. Plasma-density and electron-temperature profiles are obtained for different nonlinearity mechanisms. Equations are derived for the slow changes of the amplitude and of the phase velocity due to the influence of dissipation and dispersion. Explicit expressions for the stationary-wave amplitude in terms of the plasma parameters are obtained for the case of low supercriticality, and the condition for the instability of the wave against self-modulation is obtained. The boundary conditions on the electrodes and the conditions for the spontaneous onset of striations are discussed. (auth)

25839 IONIZATION WAVES IN A LONGITUDINALLY INHOMOGENEOUS PLASMA. Stakhanov, I.P. Sov. Phys.-Tech. Phys. 18: No. 3, 377-381 (Sept 1973).

Ionization waves can be more easily excited in a plasma that is inhomogeneous along the axis, if the ionization rate depends fairly strongly on the temperature. The additional increment associated with the inhomogeneity appears in the region adjacent to the cathode in the space between electrodes, and is greatest near the cathode. The ionization waves that arise here enter the space between electrodes (in accordance with the direction of the group velocity) and attenuate near the anode, where the decrement is greater than the growth rate. (auth)

25840 ABSORPTION AND EMISSION OF WAVES GENERATED BY AN ELECTRON BEAM IN AN INHOMOGENEOUS MAGNETOPLASMA. Demirkhanov, R.A.; Gevorkov, A.K.; Popov, A.F.; Kolmakov, O.A. Sov. Phys.–Tech. Phys. 18: No. 2, 192-196 (Aug 1973).

The propagation and damping of waves excited by an electron beam in a plasma has been investigated experimentally in various magnetic field configurations: homogeneous, decreasing, and increasing fields with various degrees of spatial inhomogeneity. In a decreasing magnetic field the possibility of efficient linear absorption of electromagnetic waves excited by a beam in the vicinity of the resonance and the harmonics is demonstrated. Damping at the first three electron cyclotron harmonics is observed on different oscillation branches. The most efficiently absorbed waves are those with frequencies $\omega_{c\text{-min}} < \omega < \omega_{c\text{-max}}$, where $\omega_{c\text{-min}}$ and $\omega_{c\text{-max}}$ are the minimum and maximum cyclotron frequencies of the inhomogeneous magnetic field. In an increasing magnetic field the transformation of a volume wave into a surface wave is observed in the vicinity of the cyclotron frequency and its harmonics. The effects of wave retardation near resonances and the singularities of the excitation and propagation of waves near the upper hybrid frequency are investigated. (auth)

25841 WAVE ABSORPTION NEAR SINGULAR POINTS IN A TWO-DIMENSIONAL INHOMOGENEOUS PLASMA. Arkhipenko, V.I.; Budnikov, V.N.; Obukhov, A.A. (A. F. Ioffe Physicotechnical Institute, Academy of Sciences of the USSR, Leningrad). Sov. Phys.–Tech. Phys. 18: No. 2, 204-206 (Aug 1973).

Wave absorption in a two-dimensional inhomogeneous plasma in a magnetic field is examined experimentally at the singular points. When $\omega < \omega_p$, $\omega_{He} > \omega > \sqrt{\omega_{He}\omega_{Hi}}$, a singularity occurs on the constant-density line for the critical value $n = n_c$ where this line is perpendicular to the magnetic field. It is shown that the absorption efficiency drops sharply when the singular point is eliminated. (auth)

25842 INTERACTION OF A MONOENERGETIC NONRELATIVISTIC ELECTRON BEAM WITH ELECTROSTATIC SURFACE OSCILLATIONS IN A PLASMA. Rukhadze, A.A.; Chogovadze, M.E. (P. N. Lebedev Physics Institute, Academy of Sciences of the USSR, Moscow). Sov. Phys.–Tech. Phys. 18: No. 2, 170-175 (Aug 1973).

The excitation of electrostatic surface electromagnetic waves is considered for a nonrelativistic monoenergetic electron beam in a plasma bounded in a vacuum or by a dielectric shell. The entire spectrum of linear oscillations is investigated and branches in which the excitation is a maximum are determined. It is shown that axially symmetric modes in a dense plasma have the maximum growth rate. The quasilinear relaxation of the hydrodynamic beam instability is discussed for these modes; stable wave amplitudes and the efficiency of transformation of beam energy into surface wave energy are also determined. (auth)

25843 HIGH-POWER ELECTROMAGNETIC TRANSMISSION CHARACTERISTICS OF A DIFFUSING REENTRY PLASMA. Papa, R.J.; Taylor, R.L. (Plasma EM Branch, Microwave Physics Laboratory, Air Force Cambridge Research Laboratories (AFSC), Laurence G. Hanscom Field, Bedford, Massachusetts 01730). J. Appl. Phys. 45: No. 2, 684-696 (Feb 1974).

Antenna voltage breakdown arising from the transmission of high-power microwave radiation may be suppressed on a reentry vehicle by injecting electrophilic chemicals into the flow field. This paper describes numerical procedures for calculating the amount of high-power microwave radiation that can be transmitted through a plasma chemically seeded with an electron-attaching substance. The power incident on a reentry plasma slab may be sufficient to induce electron temperature changes, resulting in variations in time of the electron density and effective collision frequency. The plasma properties are determined as a function of time by numerically integrating the two continuity equations for the electron and positive-ion densities. The processes of electron impact ionization, electron attachment, detachment, and recombination are taken into consideration. The diffusion of the electrons and positive ions in the ambipolar limit is influenced by the presence of negative ions. Runge-Kutta numerical integration of Maxwell's equations together with the above set of plasma transport equations yield the time-dependent plane-wave transmission and reflection coefficients as a function of incident power level for a very wide range of reentry plasma conditions. For one particular set of reentry conditions, graphs are presented of the electron density profile, reflection coefficient, and transmission coefficient as functions of time. (auth)

25844 OBSERVATION OF A BERNSTEIN WAVE PROPAGATING OBLIQUELY TO THE MAGNETIC FIELD IN A STREAMING PLASMA. Idehara, T.; Takeda, M.; Ishida, Y. (Department of Applied Physics, Fukui University, Fukui, Japan). J. Appl. Phys. 45: No. 2, 697-699 (Feb 1974).

A Bernstein wave propagating obliquely to the magnetic field is excited by a coaxial antenna in a streaming plasma and detected by an interferometer system, which shows that the dispersion relation for the wave is consistent with the theoretical result. Another wavelike signal with a shorter "wavelength" is observed downstream only of the exciting antenna, and its "phase velocity" is approximately equal to the velocity of the plasma stream calculated from the Doppler shifts of Bernstein waves in both upstream and downstream regions, which may show that the signal does not propagate as the wave but floats down on the plasma stream as the modulation of plasma particles. (auth)

25845 THEORETICAL AND EXPERIMENTAL STUDY OF THE EFFECT OF THE SHEATH ON AN ANTENNA IMMERSED IN A WARM ISOTROPIC PLASMA. Meyer, P. (Centre National d'Etudes des Télécommunications, Department RSR, 38-40, avenue du Géneral Leclerc, 92130-Issy-les-Moulineaux, France); Vernet, N.; Lassudrie-Duchesne, P. J. Appl. Phys. 45: No. 2, 700-706 (Feb 1974).

A new approach to the problem of electromagnetic wave propagation through a vacuum-plasma interface is formulated and used to solve two simple antenna problems. First, the impedance of a spherical body covered by a vacuum sheath and immersed in a plasma is calculated. The result is found to coincide with the empirical formula commonly used so far. Second, a cylindrical antenna also isolated from the plasma by a sheath is studied. The antenna can support guided modes whose dispersion relation is derived. An experiment has been performed in order to verify this desperion relation. Experimental results are found to be in favor of the present approach. (auth)

25846 EXCITATION AND DAMPING OF ELECTRON WAVES IN PLASMAS. Ito, M.; Itoh, T.; Kawabe, T.; Kawai, Y.; Nakamura, Y.; Miyatake, S. (Tokyo Univ.). Phys. Lett., 46A: No. 4, 293-294(31 Dec 1973).

Damping rates of electron plasma waves and electron burst were studied in case of large amplitude wave. (auth)

25847 SATURATING NONLINEAR DIELECTRIC CONSTANT AND SELF-FOCUSING OF ELECTROMAGNETIC WAVES IN PLASMAS: KINETIC APPROACH. Sodha, M. S.; Tewari, D. P.; Kumar, A.; Tripathi, V. K. (Indian Inst. of Tech., New Delhi). J. Phys., D (London); 7: No. 2, 345-354(21 Jan 1974).

The redistribution of electronic concentration due to heating of a plasma by a gaussian electromagnetic beam has been studied. The Boltzmann equation has been solved for the electron distribution function in the steady state, with proper account being taken of space-charge field effects. The redistribution of the carriers has been shown to be very sensitive to the velocity dependence of the collision frequency; carriers are not redistributed in a diatomic plasma, while their redistribution is a maximum for electron-ion collision-dominated plasmas. The dielectric constant shows a saturation behavior with respect to the field. The absorption tends to zero for a Coulomb collision-dominated plasma; while in a plasma having constant collision cross section, absorption tends to a constant value. The self-focusing of waves in such media resembles that observed in similar studies in dielectrics. (auth)

25848 CONVERSION OF LONGITUDINAL WAVES INTO ELECTROMAGNETIC RADIATION BY A NONUNIFORM PLASMA. Chakraborty, B. (Technical Univ., Eindhoven, Netherlands). Appl. Sci. Res. (The Hague); 28: No. 6, 466-476(Dec 1973).

Conversion of dispersive longitudinal oscillation into electromagnetic radiation field in a nonuniform warm fluid plasma is studied with the help of the linear equations of coupled wave fields deduced earlier by Chakraborty (1971). Expression for the radiated Poynting flux is obtained in the far field approximation. (auth)

25849 EXPERIMENTAL VERIFICATION OF THE RECIPROCITY THEOREM FOR ANTENNAS AND ELECTRON PLASMA WAVES. Nakamura, Y.; Itoh, T. (Tokyo Univ.). J. Plasma Phys.; 11: 131-139(Feb 1974).

The reciprocity theorem for monopole antennas, a gridded parallel plate, parallel plane grids and a plane plate, which radiate and receive an electron plasma wave in an unbounded plasma, was introduced theoretically, based on the electron fluid model. The theorem held experimentally if the dc bias potential of the antennas was lower than the floating potential. The measured reception pattern of an antenna was equal to its radiation pattern. The wave amplitude and the impedance between the antenna and the plasma were measured experimentally. (auth)

25850 NOTE ON THE APPLICATION OF WHITHAM'S METHOD TO NONLINEAR WAVES IN DISPERSIVE MEDIA. Dysthe, K. B. (Univ., Tromsoe, Norway). J. Plasma Phys.; 11: 63-76(Feb 1974).

A method developed by Whitham (Whitham, G. B., 1965a Proc. Roy. Soc.A. 283; 1965b J. Fluid Mech. 22, 273; 1967 Proc. Roy. Soc. A. 299, 6) for obtaining equations governing the slow variation of finite-amplitude wave trains, was slightly modified. The relevant equations describing wave–wave interaction, and self-action were derived. The stability of a finite-amplitude wave train was treated in two different ways. The possibility of having a "solitary modulation" on a finite-amplitude wave train was pointed out. (auth)

25851 OBLIQUE AND SKEW IONIZING SHOCK WAVES WITH NONUNIQUE STRUCTURE. Leonard, B. P. (City Univ., New York). J. Plasma Phys.; 11: 51-62(Feb 1974).

Within the range in which both electric field parameters are free, ionizing shock waves have a unique structure for each pair of chosen parameter values. In a relatively small shock speed range, however, conditions may exist for which at least one intermediate equilibrium region is imbedded within the overall transition. Non-unique structures consisting of different transitions between the same upstream and downstream equilibrium states may then occur. Steady trans-Alfvenic magnetohydrodynamic transitions (which are unacceptable in the pre-ionized case) may occur as part of an ionizing shock structure, because neighboring steady solutions always exist. This is due to the existence of skew ionizing shocks which are able to absorb rotational disturbances. (auth)

25852 ATTENUATION OF LONGITUDINAL ELECTRO-ACOUSTIC WAVES IN A PLASMA. Papa, R. J.; Lindstrom, P. (Air Force Cambridge Research Labs., L. G. Hanscom Field, MA). J. Plasma Phys.; 11: 37-49(Feb 1974).

There are several practical situations in partially ionized plasmas when both collisionless (Landau) damping and electron-neutral collisions contribute to the attenuation of longitudinal waves. The longitudinal-wave dispersion relation is derived from Maxwell's equations and the linearized Boltzmann equation, in which electron–neutral collisions are represented by a Bhatnagar–Gross–Krook model that conserves particles locally. The dispersion relation predicts that, for a given signal frequency w, an infinite number of complex wavenumbers k_n can exist. Using Fourier–Laplace transform techniques, an integral representation for the electric field of the longitudinal waves was readily derived. Then, using theorems from complex variable theory, a modal expansion of the electric field could be made in terms of an infinite sum of confluent hypergeometric functions, whose arguments were proportional to the complex wavenumbers k_n. It was demonstrated numerically that the spatial integral of the square of the electric field amplitude decreased as the electron-neutral collision frequency increased. Also, the amount of energy contained in the first few (lowest) modes, and the coupling between the modes, was examined as a function of plasma frequency, signal frequency, and collision frequency. (auth)

25853 RELAXATION OSCILLATIONS IN WEAK TURBULENCE: THE CASE OF NONLINEAR WAVE–PARTICLE INTERACTION. Montes, C. (Observatoire, Nice). J. Plasma Phys.; 11: 141-158 (Feb 1974).

A model for nonlinear Landau stabilization of a linear instability was treated analytically. The model may be applied to any dissipative system described by: (1) a linear dissipation function $\gamma(k)$, of one degree of freedom k, which presents a limited unstable domain Δ k and a damped region for lower values of k, and (2) a transition probability for the nonlinear Landau damping (nonlinear wave-particle interaction) proportional to $k-k'$. For a sharply pointed $\gamma(k)$, the model led to a kinetic regime presenting periodic relaxation oscillations of large and constant amplitude. Starting from weak turbulence, the system organized itself into a periodic regime, which may be of interest in connection with research in morphogenesis. For a smoothed $\gamma(k)$, the relaxation oscillations damp, slowing down towards a turbulent energy level. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 24231, 24813, 25162, 25182, 25536, and 26489.

25854 (AD-765315-7) TRANSPORT THEORY OF PENETRATION BY HEAVY IONS. Manning, I.; Padgett, D. W. (Naval Research Lab., Washington, D. C. (USA)). Aug 1973. 32p. NTIS $3.00.

The penetration of matter by a heavy-ion beam is considered from the standpoint of the Boltzmann transport equation. It is assumed that the target may be modeled as being amorphous. This approach is worked out in detail, using the Lindhard theory for atomic collisions, and extended to include the transport properties of recoil atoms. The ultimate aim is to use the power of modern high-speed computers to numerically solve the transport equation using realistic approximations. The connection with Landau–Vavilov theories is examined. The solution of the transport equation near the penetrating surface is discussed; this discussion can be the basis of a self-contained theory of surface phenomena. Some of the implications of the approach, should it be successfully implemented, are mentioned. (auth)

25855 (CEX-73.1) DISTRIBUTION FUNCTIONS OF AIR-SCATTERED GAMMA RAYS ABOVE ISOTROPIC PLANE SOURCES. Michael, J. A.; Lamonds, H. A. (EG and G, Inc., Santa Barbara, Calif. (USA); USAEC Division of Biology and Medicine, Washington, D. C. Civil Effects Branch). Jun 1967. 414p. Dep. NTIS $10.60.

Using the moments method of Spencer and Fano and a reconstruction technique suggested by Berger, the authors have calculated energy and angular distribution functions for air-scattered gamma rays emitted from infinite-plane isotropic monoenergetic sources as functions of source energy, radiation incidence angle at the detector, and detector altitude. Incremental and total buildup factors have been calculated for both number and exposure. The results are presented in tabular form for a detector located at altitudes of 3, 50, 100, 200, 300, 400, 500, and 1000 feet above source planes of 15 discrete energies spanning the range of 0.1 to 3.0 MeV. Calculational techniques including results of sensitivity studies are discussed and plots of typical results are presented. (auth)

25856 (IA-1292) NASIF: A FULLY AUTOMATIC CODE FOR THE CALCULATION OF SHIELDING FACTORS FROM ENDF/B-III TAPES. Gur, Y.; Yiftah, S. (Israel Atomic Energy Commission, Tel Aviv). Nov 1973. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

NASIF is a fully automatic code for the generation of group shielding factors from resonance parameters in the resolved and unresolved resonance region. The algorithms of the code are described. The main differences between algorithms used in this code and algorithms used in other codes, such as ENDRUN-II and ETOX, are discussed. (auth)

25857 (ORNL-TM-4296) ISODATA: A COMPUTER PROGRAM FOR CALCULATING ISODATA CONTOURS. Anderson, V. E.; Hamm, R. N.; Turner, J. E.; Wright, H. A.; Alsmiller, R. G. Jr.; Armstrong, T. W. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. Contract W-7405-eng-26. 17p. Dep. NTIS $3.00.

The computer program, ISODATA, is described for the calculation of isodata contours for a set of data specified numerically over a discrete, two-dimensional grid of points. (auth)

25858 (ORNL-TM-4419) ENERGY DEPOSITION BY HIGH-ENERGY ELECTRONS (50 TO 200 MeV) IN WATER. Alsmiller, R. G. Jr.; Barish, J.; Dodge, S. R. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. Contract W-7405-eng-26. 24p. Dep. NTIS $3.25.

The data presented here are intended for use in studying the effects of electron contamination in negatively charged pion beams which are used in cancer radiotherapy. Electron–photon cascade calculations have been carried out for zero-width beams of electrons with kinetic energies of 50, 100, 150, and 200 MeV normally incident on a water phantom. The energy deposition per unit volume as a function of depth and radius in the phantom is given. To make the results more accessible for treatment planning, a quasi-analytic representation of the energy-deposition data has been obtained and is presented. (auth)

25859 (ORNL-TM-4442) CALCULATIONS PERTAINING TO THE USE OF FAST (≤ 50 MeV) NEUTRONS IN CANCER RADIOTHERAPY. Alsmiller, R. G. Jr.; Barish, J. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. Contract W-7405-eng-26. 34p. Dep. NTIS $3.75.

Calculated results are presented for a variety of neutron spectra incident on a tissue-equivalent phantom. The neutron spectra considered are those produced by 35- and 50-MeV deuterons in a thick beryllium target and by 67-MeV protons in a thick lithium target. Results are presented for the absorbed doses, LET spectra, cell-survival probabilities, OERs, and RBEs as a function of position in the phantom. The cell-inactivation calculations were carried out using the model of Katz et al. and parameters for T-1 kidney cells. In the case of incident neutrons from 35-MeV ^{2}H on Be, experimental and calculated absorbed-dose data are compared as a function of position in the phantom and are shown to be in good agreement. (auth)

25860 (ORNL-tr-2794) MORSE-K PROGRAM PACKAGE VERSION 1: A MONTE CARLO PROGRAM SYSTEM FOR SMALL COMPUTERS. Schmidt, F. A. R.; Bernnat, W. (Stuttgart Univ. (TH) (F.R. Germany). Inst. fuer Kernenergetik). Dec 1972. Translation by Ernest G. Silver of German Report 4-11. 146p. Dep. NTIS $9.50.

MORSE-K is a multigroup Monte Carlo program. It can be used for core, shielding, and perturbation calculations both for neutrons and gamma rays. MORSE-K was developed at the Institut für Kernenergetik in Stuttgart, Germany, from the ORNL program MORSE. This report describes MORSE-K and presents examples for its various applications. (15 figures, 30 tables) (auth)

25861 (RFP-TRANS-151) DETERMINATION OF THE RANGE OF ACCELERATED IONS IN THIN OXIDE FILMS. Bach, H. Translated from Z. Angew. Phys.; 28: 239-244(1970). 10p. Dep. NTIS $3.00.

A method is described for the determination of the range of accelerated ions in the oxide films on glass substrates, whereby these films are sputtered by the ions. The differential range distribution of the ions is obtained from the recorded variation of the spectral luminescence intensity that occurs when the ions, during uniform sputtering of the films, penetrate into a glass substrate with stronger or weaker luminescence. Said method has been applied for the determination of the mean range of A^+ ions of 4.2 and 5.6 keV energy in thin organogenic SiO_2 and TiO_2 films. The values ascertained for the mean specific energy losses from measurements of the ranges in SiO_2 and TiO_2 are compared with the specific energy losses predicted according to the theory by Lindhard et al. (auth)

25862 (UCRL-51493) ETRANMS: A ONE-DIMENSIONAL MONTE CARLO ELECTRON/PHOTON TRANSPORT CODE FOR MULTIMATERIAL TARGETS. Kovar, F. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Nov 1973. Contract W-7405-eng-48. 27p. Dep. NTIS $4.00.

ETRANMS is an LLL-modified version of the one-dimensional electron/photon transport code ETRAN 15 developed at the National Bureau of Standards. The major modifications include the use of LLL photon cross sections and the application to multislab, multimaterial targets. The code uses Monte Carlo sampling techniques to calculate electron and photon transport and energy and charge deposition within target material subjected to electron or photon radiation. It has been programmed to be a very rapid running, user-oriented code for use on LLL's CDC 7600 computers. (auth)

25863 (UCRL-75094(Rev. 1)) EXCITATION STATES OF PROJECTILES MOVING THROUGH SOLIDS. Fortner, R. J.; Garcia, J. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1973. 10p. (CONF-730958-4). Dep. NTIS $3.00.

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973).

X-ray spectral measurements of S, Cl, and Ar atoms moving in solid carbon targets are used to extract the equilibrium distribution of vacancies in the valence and L-shells of the projectiles. It is found that the state of excitation is much higher than the mean charge measured after the projectile has left the solid. A simple model is used to deduce the expected final charge state distribution, and these are compared to thin foil measurements. (auth)

25864 INVESTIGATION OF KILOVOLT ELECTRON ENERGY DISSIPATION IN SOLIDS. Matsukawa, T.; Shimizu, R. (Department of Applied Physics, Osaka University, Suita, Osaka, Japan); Harada, K.; Kato, T. J. Appl. Phys. 45: No. 2, 733-740 (Feb 1974).

A new technique to determine the depth distribution of energy loss, the so-called depth-dose function, is described for electrons whose energies ranged from 15 to 30 keV at normal and 45 ° incident angles.

This method is based on a series of measurements of currents induced by the penetration of energetic electrons through a metal-oxide-semiconductor-structure (Al-SiO_2-Si) specimen whose metal electrode is formed by an aluminum layer deposited in a stepwise manner. The experimental depth-dose function and range-energy relation are compared with other experimental and theoretical results. A particular interest was taken in the comparison of the experimental results with those predicted by our Monte Carlo calculations to confirm the good agreement between them. Furthermore, the ratio of the product of mobility and lifetime to the mean electron excitation energy in SiO_2 was also determined to be $\mu\tau/E_A = 0.10 \times 10^{-11}$ cm/V^2, which may be ranked between the values reported by Everhart and Hoff and by Goodman. The effects of space charge in SiO_2 are also discussed. (auth)

25865 INFLUENCE OF THE $Z^3{}_1$ CONTRIBUTION TO STOPPING POWER ON THE EVALUATION OF MEAN EXCITATION POTENTIALS AND SHELL CORRECTIONS. Ashley, J.C. (Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. B 9: No. 1, 334-336 (1 Jan 1974).

The careful experimental evaluations of mean excitation potentials and of shell corrections need to be reexamined in view of the recent theoretical evaluation of the $Z^3{}_1$ contribution to the stopping power of matter for charged particles. We present here stopping power formulas including the $Z^3{}_1$ contribution and apply these to recalculate the excitation potentials and shell corrections derived from very precise measurements of stopping power for some elements in $20 \leq Z_2 \leq 30$. Including the $Z^3{}_1$ contribution does not appear to produce a significant change (considering current experimental accuracy) in the mean excitation potentials for elements in this range, but important changes are found in both the shape and magnitude of the shell-correction curves. (auth)

25866 CONSIDERATIONS CONCERNING THE STRAGGLING OF 100-MeV PROTONS IN Xe. Bichsel, H. (Department of Radiology, University of Washington, Seattle, Washington 98195). Phys. Rev. A 9: No. 1, 571-575 (Jan 1974).

The interpretation of straggling experiments in thin absorbers is examined. It is made plausible that the Landau-type solutions of the transport equation are invalid for very thin absorbers. Another solution of the problem is presented. It is shown that the customarily assumed form of the atomic-structure correction for the straggling parameter is incorrect. Finally, various effects influencing the relation between energy lost by the charged particles and the ionization observed in the absorber material are enumerated. (auth)

25867 LARGE-ANGLE POSITRON SCATTERING. Rupaal, A.S.; Spanel, L.E. (Western Washington State College, Bellingham, Washington 98225). Phys. Rev. A 9: No. 1, 283-285 (Jan 1974).

Using the Thomas-Fermi distribution for the electronic charge in an atom, Landau and Lifshitz have shown that Born's formula for scattering applied to the elastic scattering of electrons yields the scattering cross section $\sigma = (\mathrm{const})(Z^{4/3}/v^2)$, where v is the velocity of the incident electrons. This relation gives, for the Z dependence of the transmitted intensity of electrons from a radioactive source through different absorbers an equation of the form $t/A = KZ^{-4/3}$, where t is the thickness in mg/cm^2 of the absorber needed to obtain a given transmitted intensity, A is the mass of the atom of the absorber, and K is a constant. Experimental results for the scattering of positrons by atoms in their passage through thin metallic foils indicate that the same relation is also valid for positron scattering in the range 300 keV to 2 MeV. A simple interpretation of this relationship is also given. (auth)

25868 ENERGY STRAGGLING OF ^{4}He BELOW 2 MeV IN PT. Harris, J. M.; Chu, W. K.; Nicolet, M. A. (California Inst. of Tech., Pasadena). Thin Solid Films; 19: No. 2, 259-265(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

Energy straggling of ^{4}He was measured in Pt films ranging from 200 to 4500 Å. The measurement was made by backscattering spectrometry at energies below 2.0 MeV. The results lie between the predictions of Bohr's and Lindhard and Scharff's theories. Straggling is roughly proportional to the square root of the thickness, but also depends slightly on energy. (auth)

25869 STOPPING OF ^{4}He IONS IN ELEMENTAL MATTER. Ziegler, J. F.; Chu, W. K. (IBM Watson Research Center, Yorktown Heights, NY). Thin Solid Films; 19: No. 2, 281-287 (17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

The recent increased use of high energy ions to analyze solid state materials has led to new interest in the study of ion interactions with matter. These recent solid state experiments, whether using nuclear back-scattering, channelling or ion-induced x-rays, need not only cross section information but also values of the energy loss of ions in matter. Many of the recent solid state investigations using nuclear microanalysis techniques have used ^{4}He ion beams. This ion has few nuclear reaction resonances with target nuclei in the energy range 400-4000 keV and can be detected with good energy resolution. Recent experimental values for the energy loss of ^{4}He ions in matter have been measured for some 47 elements. The Baylor University group has also conducted extensive calculations of stopping cross sections of ^{4}He ions in matter using the theories of Lindhard and Winther and Bonderup with Hartree-Fock-Slater charge distributions. Their results show that both these theories give similar values and show an oscillatory dependence of energy loss cross section of ^{4}He ions as a function of the atomic number of the target material; the Bonderup values are about 7% lower than those from the Lindhard-Winther theory. A phenomenological study of many kinds of ions in matter has also been published by Northcliffe and Schilling but they tabulate values for only 21 elements for ^{4}He ions, and these have almost all been superseded by more recent experimental measurements. Here, the previous calculations for the Lindhard-Winther theory are combined with the existing experimental values of stopping cross sections to produce semi-empirical values of stopping cross sections for ^{4}He ions in all elements for the energy range 400 to 4000 keV. Finally these values are used to calculate back-scattering parameters which allow direct conversion of the energy width of peaks to film thickness. (auth)

25870 MAXIMUM PERMISSIBLE RADIATION DOSES. Fosmark, H.; Johansen, J.; Klokk, A.; Strickert, T.; Aamlid, H. (Statens Institutt for Straalenhygiene, Oslo). pp 168-176 of Straalefysikk, Straaleterapi, Straalehygiene, Straalebiologi. Klokk, A. (ed.). Oslo; Statens Institutt for Straalehygiene (1973). (In Norwegian).

The background for the ICRP recommendations on maximum allowable radiation doses is explained; the maximum allowable doses for occupational exposure, the general public, for whole body and local doses, in pregnancy etc., are summarized. Norwegian regulations for medical checks for occupationally exposed workers are stated. Doses received under radiological examinations are briefly discussed. A summary of techniques for dose monitoring concludes the chapter. (NO)

25871 ABSORPTION OF IONIZING RADIATION IN BIOLOGICAL MATERIALS. Fosmark, H.; Johansen, J.; Klokk, A.; Strickert, T.; Aamlid, H. (Statens Institutt for Straalenhygiene, Oslo). pp 79-89 of Straalefysikk, straaleterapi, straalehygiene, straalebiologi. Klokk, A. (ed.). Oslo; Statens Institut for Straalehygiene (1973). (In Norwegian).

In considering the absorption of ionizing radiation in biological material the relationship between a rad and roentgen (R) is first explained and values for the ratio rad/Roentgen given graphically (10 to 10000 keV) for bone, muscle and fat and tabularly (20 to 2000 keV) for muscle and bone. The significance of the absorption of x radiation in different materials at different energies for therapy and radiography is briefly discussed. Depth dose distribution curves are presented and explained, and shadowing by bone and the penetration of x radiation in patients with various filter thicknesses discussed. (NO)

25872 FIRST COLLISION GAMMA-RAY DOSE. Hubbard, L. B. (Furman Univ., Greenville, SC). Comput. Phys. Commun.; 6: No. 5, 240-242(Nov 1973).

Improvements in the computer code DOSE-I are discussed. A geometric symmetry in the attenuation integral speeds execution. When reflectional or rotational symmetries exist in both source and matter distributions these can be utilized to speed execution. The attenuation in the source and target sub-volumes is added by three formulae adapted from spheres; two are in the literature and one is based on a point source. (MHR)

25873 MEASUREMENT OF γ-RAY ATTENUATION COEFFICIENTS. Christmas, P. (National Physical Lab., Teddington, Eng.). Int. J. Appl. Radiat. Isotop.; 25: No. 1, 25-29(Jan 1974).

Gamma-ray attenuation coefficients have been determined for aluminium, copper, tin, platinum and lead (elements with Z between 13 and 82) using γ-rays with energies between 295 and 2440 keV from a sealed Ra-226 source. A lithium-drifted germanium detector was employed without collimation or shielding. The average standard error of the experimental results was 1%. (auth)

25874 BRAGG'S RULE STUDY IN BINARY METAL ALLOYS AND METAL OXIDES FOR MeV $^4He^+$ IONS. Feng, J. S. Y.; Chu, W. K.; Nicolet, M. A. (California Inst. of Tech., Pasadena). Thin Solid Films; 19: No. 2, 227-238(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

A self-consistent procedure for testing Bragg's rule in solids is described and applied to ${}^{4}He^{+}$ ions between 0.5 and 2.25 MeV for the binary metal systems Au–Ag, Au–Cu and Au–Al. The validity of the procedure is verified by numerical analysis. Bragg's rule correctly predicts the energy loss in Au–Al and Au–Ag mixtures to within the 1% sensitivity of the experiment and to within 2% in Au–Cu alloys. It is proposed that Bragg's rule is valid for all metal alloys. A second method has been applied to the oxides of iron and aluminum. This "yield ratio test" assumes that the composition of the target and the elemental stopping cross sections are known. The measured relative stopping powers in α-Fe_2O_3 and Fe_3O_4 are consistent with the use of Bragg's rule and the available elemental stopping data. The relative stopping power in Al_2O_3 differs by about 10% from the expected value. (auth)

25875 POSTOPERATIVE RADIOTHERAPY OF BREAST CANCER. Investigations About Optimal Dose Distribution in Irradiation of the Thoracic Wall by Tangential Fields. II. Heilmann, H. P. (Univ., Tuebingen, Ger.). Strahlentherapie; 146: No. 3, 268-288(Sep 1973). (In German).

Experimental investigations are reported for the study of dose distributions on the thoracic wall in irradiation via tangential standing fields. A special water-model with particularly thin walls as well as a Machlett-Alderson-Rando-Man-Phantom were used for the measurements. The dosimetry was performed by ionometry with a micro-tube-chamber and the Duplex-dosimeter on the water-phantom, by thermoluminescence dosimetry with LiF TLD-100 dosimeters on the Alderson-phantom. The measured values were recorded on punched tapes and processed in a computer. By arithmetic superimposition of the counter-fields the isodoses of the superimposition could be demonstrated. The arithmetic variation of the irradiation parameters (angle of incidence, exposure) made it possible to study various modes of irradiation. The measurements were made for kilovolt technique, the tele-cesium-apparatus, the tele-cobalt apparatus, and the 17-MeV-Betatron for ultrahard x-ray radiation. The accuracy of the dose distributions found on the water-model could be tested by comparison with the results obtained on the body-equivalent model. With tele-cesium, tele-cobalt and ultrahard x-rays using tangential counter-fields, an equal perradiation of the thoracic wall was attained, with adequate to satisfactory protection of the lung tissue, whereas the conventional deep x-ray therapy did not guarantee satisfactory dose distributions. An improvement of the dose distribution by different exposure of the fields was not possible. Differences of the dose distribution on the Alderson model are caused by inhomogeneities of the tissues. With the kilovolt-technique, particularly before the superimposition of the standing fields, a marked influence caused by inhomogeneities was observed. Conclusions are drawn for practical radiotherapy and a technique of adjustment to the patient was described which permits reproducible irradiations and the use of the resulting isodoses. (GE)

25876 STUDY OF THE PURITY OF ${}^{99m}Tc$ SUBLIMED FROM FISSION ${}^{99}Mo$ AND THE RADIATION DOSE FROM THE IMPURITIES. Colombetti, L. G. (Veterans Administration Hospital, Hines, IL); Husak, V.; Dvorak, V. Int. J. Appl. Radiat. Isotop.; 25: No. 1, 35-41(Jan 1974).

The principal radionuclidic impurities in ${}^{99m}Tc$ sublimed from fission molybdenum product have been measured. The radioactive impurities were measured by γ-ray spectrometric analysis using Ge(Li) solid state detectors. Calculations showed that the activities due to these impurities is very low when compared with the activity of the technetium. ${}^{131}I$ was found to be the principal source of extraneous activity. The other impurities were: ${}^{99}Mo$, ${}^{103}Ru$, ${}^{106}Ru$ and ${}^{132}Te$. The contribution due to these impurities to the total absorbed dose is significant. The extra dose to the patient from the impurities in typical runs from one generator was calculated to be 0.17% for the first sublimation, and 0.11 and 0.0013% for the second and third sublimations, respectively, of the dose from the ${}^{99m}Tc$ administered. (auth)

25877 STORAGE AND MANIPULATION OF RADIATION DOSE DATA IN A SMALL DIGITAL COMPUTER. Milan, J.; Bentley, R. E. (Inst. of Cancer Research, Sutton, Eng.). Brit. J. Radiol.; 47: No. 554, 115-121(Feb 1974).

A small dedicated computer (PDP-8) has been in routine use for three years for the production of dose distributions for 1,000 patients per year. It has completely replaced hand drawing procedures. Details are given of the physical and computing principles employed in the system. A method of beam tabulation designed to minimize the amount of data stored in the computer and suitable for a wide variety of beams is described. This method has been found to give accurate results in all parts of filtered or unfiltered beams produced by cobalt 60 and by 6 MeV and 8 MeV linear accelerators. A correction procedure is used which makes accurate compensation for skin curvature and for variations in SSD, which occur in isocentric treatments. The method has been further developed to compensate for tissue inhomogeneities such as bone and lung, with little reduction in speed of calculation. Finally, methods are described which have been used to obtain beam data in the right form for storage and subsequent retrieval. (auth)

25878 MOLECULAR EFFECTS IN ENERGY LOSS OF ALPHA PARTICLES IN GASEOUS MEDIA. Powers, D.; Lodhi, A. S.; Lin, W. K.; Cox, H. L. Jr. (Baylor Univ., Waco, TX). Thin Solid Films; 19: No. 2, 205-215(17 Dec 1973).

From international conference on ion beam surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

Previous measurements in gaseous hydrocarbon and carbon–oxygen compounds in the range $0.3 \leqq E_{\alpha} \leqq 2.0$ MeV revealed that the Bragg additive rule failed to give molecular stopping cross sections ϵ_{α} from the measured atomic solid carbon stopping cross section $\epsilon(C)$ and diatomic $\epsilon_{expt}(H_2)$ or $\epsilon_{expt}(O_2)$. For example, when hydrogen was present in the compound, the molecular data could be fitted either by using $\epsilon(C)$ and an $\epsilon'(H)$ which was higher than $\frac{1}{2}\epsilon_{expt}(H_2)$ by as much as 21%, or by using $\frac{1}{2}\epsilon_{expt}(H_2)$ and another $\epsilon'(C)$ which was greater than $\epsilon(C)$ by as much as 22%. A similar difficulty has also been encountered in interpreting the stopping cross sections recently measured for C–H–F and C–H–O compounds. $\epsilon(C)$, $\epsilon_{expt}(H_2)$ and $\epsilon_{expt}(O_2)$ can be used to fit $(CH_3)_2O$, but it is necessary to use $\epsilon'(C)$ and $\epsilon_{expt}(H_2)$ for $C_2H_2F_2$. Nevertheless, a closer examination of the stopping cross sections for eight hydrocarbon compounds reveals a correlation between the stopping cross sections of atomic hydrogen and carbon which are required to satisfy the Bragg rule, and the type of bond associated with the atomic carbon in the molecule. The stopping cross section of a carbon atom is greater when the atom is bound by a triple bond than a single bond, whereas that of a hydrogen atom is less in a triple-bond compound than in a single-bond compound. Double-bonded compounds yield a carbon stopping cross section between the single-bond and triple-bond values at lower energies and closer to the triple-bond values at higher energies. (auth)

25879 METHOD OF CALCULATING THE ISODOSE SHIFT IN CORRECTING FOR OBLIQUE INCIDENCE IN RADIOTHERAPY. Giessen, P. H. V. D. (Radio-Therapeutisch Instituut, Tilburg, Netherlands). Brit. J. Radiol.; 46: No. 551, 978-982(Nov 1973).

A theoretical basis is put forward for the "isodose shift" method of correcting for beam obliquity in radiotherapy. A formula is deduced for the shift factor, i.e. the fraction of the gap t along a given ray by which the isodose curve must be moved. When t is small compared with the SSD, the shift factor is independent of t, but does depend on the radiation energy, SSD, field area and depth in the absorbing medium. For depths below about 7 cm, the factor for a given beam is sensibly constant. It is further shown that a single value of the factor may be used for all fields and depths (for a given radiation and SSD) with an error of up to 1 per cent for depths below 7 cm and up to about 2 per cent for smaller depths. The recommended average shift factor for 100 cm SSD is 0.7 for x rays from 1 to 5 MV (including ${}^{60}Co$ γ rays) and 0.6 for x rays from 5 to 15 MV. The calculated values agreed well with empirical values found in the literature. (auth)

25880 SOME PITFALLS WHEN MEASURING X-RAY QUALITY. Ardran, G. M.; Crooks, H. E. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Brit. J. Radiol.; 46: No. 551, 1010-1011(Nov 1973).

In view of the increasing use of the Copper Reference Number (CRN) method of determining the effective kilovoltage (kVp), it is pointed out that owing to the instability of many x-ray generators, (switching, stabilization, compensation etc.), exposures of less than 0.1 sec and sometimes longer may give erratic waveforms and thus different kVp values. Measurements are presented which show firstly the variation of effective kVp when using different set values for tube current up to 300 mA, and voltage up to 150kV, and secondly variations in kV and x-ray output with differing exposure times. It is also stressed that the correct size and location of the copper filter is essential to the correct operation of the authors' pentrameter cassette used to determine the CRM. The changes of filtration required to give pentrameter cassette readings correct to 1 kV down to 20 kV with molybdenum, rather than tungsten targets, are given. (UK)

25881 ANALYSIS OF THE BIOLOGICAL EFFECTIVENESS OF NEUTRONS UNDER EMERGENCY CONDITIONS. Doerschel, B.; Herforth, L. (Technische Univ., Dresden). Kernenergie; 16: No. 10, 311-317(Oct 1973). (In German).

For various somatic injuries the biological effectiveness of neutrons has been proved to be higher than that of gamma radiation. Because of the different lesion mechanism, for acute mortality the RBE is expected to be higher than unity. The RBE is discussed as a function of LET and neutron energy. From the studies of the biological effectiveness of neutrons conclusions may be drawn for emergency neutron dosimetry. (auth)

25882 TKANEVYA DOZY NEITRONOV V TELE CHELOVEKA. (Tissue Neutron Doses in the Body). Zolotukhin, V. G.; Keirim-Markus, I. B.; Kochetkov, O. A.; Obaturov, G. M.; Tsvetkov, V. I. Moscow; Atomizdat (1972). 320p. (In Russian).

Reference data on the distribution of the tissue dose of monoenergetic neutrons in the body are presented. Methods for the calculation of the tissue dose are given. The distribution of the absorbed dose and the dose equivalent under different directions of neutron incidence is examined with consideration of the geometry of the human body. A large quantity of original graphic material is included. (tr-auth)

25883 CONVERSION FROM AN ENERGY SCALE TO A DEPTH SCALE IN CHANNELING EXPERIMENTS. Boettiger, J.; Eisen, F. H. (Rockwell International, Thousand Oaks, CA). Thin Solid Films; 19: No. 2, 239-246(17 Dec 1973).

From international conference on ion beams surface layer analysis; Yorktown Heights, NY (18 Jun 1973).

The problem of determining the appropriate value of the stopping power to be used in obtaining depth information from back-scattering measurements using the channelling effect technique was studied by observing the energy spectra of 0.2 and 0.4 MeV protons transmitted through thin (~1 μm) silicon crystals. The transmitted particles were detected and energy analyzed with an electrostatic analyzer at scattering angles of 0°, 10° and 15°. It is concluded that the stopping power to be used in dechannelling experiments and localization studies of substitutional impurities should be the random stopping power. In the case of buried damage layer the appropriate stopping power is that derived from the most probable energy loss of the channelled protons. It is proposed that the results of these experiments can be generalized to channelling effect measurements at other energies and with different projectiles and targets. (auth)

25884 RADIATION DOSE TABLES. Fosmark, H.; Johansen, J.; Klokk, A.; Strickert, T.; Aamlid, H. (Statens Institutt for Straalenhygiene, Oslo). pp 145-155 of Straalefysikk, Straaleterapi, Straalehygiene, Straalebiologi. Klokk, A. (ed.). Oslo; Statens Institutt for Straalehygiene (1973). (In Norwegian).

The construction and use of dose tables, taking backscattering and radiation quality into account, are explained. An example of the calculation of the irradiation time is given. A table is given relating errors in adjustment of the equipment and irradiation time to errors in the dose. (NO)

25885 TABLE OF EXPOSURE RATE CONSTANTS Γ_δ. Guiho, J. P.; Hillion, P. (CEN de Saclay, Gif-sur-Yvette, France). Int. J. Appl. Radiat. Isotop.; 25: No. 3, 105-111(Mar 1974). (In French).

Exposure rate constants and specific γ ray constants have been calculated for the following radionuclides: ^{24}Na, ^{42}K, ^{51}Cr, ^{56}Mn, ^{59}Fe, ^{60}Co, ^{64}Cu, ^{65}Zn, ^{82}Br, ^{99}Mo + ^{99}Tc, ^{113}Sn + ^{113}In, ^{113}In, ^{124}Sb, ^{125}I, ^{131}I, ^{137}Cs + ^{137}Ba, ^{141}Ce, ^{170}Tm, ^{192}Ir, ^{198}Au, ^{203}Hg, and ^{226}Ra + ... These results have been compared to experimental values determined by the authors or published in literature. For each radionuclide it is recommendable to use one constant value for Γ and Γ_δ. (auth)

25886 FINITE DIFFERENCE SCHEME FOR TIME-DEPENDENT SPHERICAL RADIATION HYDRODYNAMICS PROBLEMS. Zinn, J. (Los Alamos Scientific Lab., NM). J. Comput. Phys.; 13: No. 4, 569-590(Dec 1973).

A fast and simple computational procedure for a class of time-dependent radiation transport hydrodynamics problems with spherical symmetry is described. Local thermodynamic equilibrium is assumed, and effects of time-of-flight retardation of photons are not considered. A two-stream assumption is used wherein the monochromatic intensity function at each given point has one value for directions falling within a prescribed cone and another value for directions outside of that cone. A use of the method is illustrated in a computation of the growth of a nuclear fireball. (auth)

25887 SOME DOSIMETRICAL PROBLEMS OF A BIOLOGICAL IRRADIATION FACILITY. Zarand, P.; Makra, S.; Santha, A.; Mandi, E. (Orszagos Frederic Joliot-Curie Sugarbiologiai es Sugaregeszsegugyi Kutato Intezet, Budapest). pp 315-319 of Radiation Biophysics, Free Radicals. Vol. II. Broda, E. (ed.). Vienna; Wiener Medizinische Akademie (1971).

From 1st European biophysics congress; Baden, Austria (14 Sep 1971).

A dosimetrical method based on a threshold detector system (In, Al, S, P) and neutron spectrum calculation is presented. If the 1/E part of a leakage spectrum is filtered with B_4C this method may be used in place of techniques requiring expensive fission foils. The kerma values obtained with different computer codes agree within ±5%. (auth)

25888 EMISSION OF BREMSSTRAHLUNG IN THE SCHWARZ–HORA EFFECT. La Fleur, P. L. (Catholic Univ., Nijmegen, Netherlands). Lett. Nuovo Cim.; 8: No. 8, 520-524(20 Oct 1973).

An attempt is made to explain the Schwarz–Hora effect by considering the bremsstrahlung emitted by the electrons when the last ones hit the nonfluorescent screen. (MHR)

25889 PERSONNEL MONITORING IN DIAGNOSTIC RADIOLOGY. Moore, R. D.; Robinson, A.; Plested, K. J. (Weston Instruments, Inc., Newark, NJ). Brit. J. Radiol.; 46: No. 551, 1011-1012(Nov 1973).

A brief attempt is made to clarify the reasons for conflicting data obtained for the ratio of doses received by an unshielded film worn at the collar, to that received by a film placed on the trunk and beneath a lead apron. Attention is drawn to differences in patterns of work for radiologists and radiographers, to variations in the average energy of the radiation and the lead equivalence of the aprons. Data from a small scale trial with radiologists involved in a substantial amount of gastrointestinal fluoroscopic work at kilovoltages in the range 90 to 100 kVp, showed that the ratio of doses outside to inside aprons of 0.35 mm LE at chest level, was 9 : 1. It is suggested that results indicate that many radiologists are engaged in work of a nature that 100% MPD is likely to be approached more rapidly for unshielded than shielded parts of their bodies. (UK)

Radiation Protection Standards

Refer also to abstracts 26461 and 26462.

25890 X-RAY DECREE OF MARCH 1, 1973. Bischof, W. (Univ., Goettingen, Ger.). Fortschr. Geb. Roentgenstr. Nuklearmed.; 119: No. 5, 513-529(Nov 1973). (In German).

The x-ray decree of March 1, 1973 is the first comprehensive legal regulation for the use of x rays in the FRG, i.e., it regulates the use of x-ray devices not only in human and veterinary medicine but also in the natural sciences and in industrial and technical fields. The recommendations of the ICRP and of the ICRU are taken here into account. The field of application of the decree is determined by a minimum (3 MeV) and a maximum (5 KeV) limit value of x-ray energy. All x-ray equipments and parasitic radiation emitters falling within those limits will undergo a federal control from the effective day (1-9-73) onwards. The decree gives a very detailed legal regulation as regards the use of x ray for the examination of living persons. (GE)

25891 USE OF INVESTIGATION LEVELS. Dunster, H. J. (National Radiological Protection Board Harwell, Eng.). Radiol. Prot. Bull.; No. 6, 3-6(Jan 1974).

A brief summary is presented of the general concepts of investigation levels, with reference to ICRP recommendations. The advantages and limitations of using investigation levels are briefly discussed. Reference is made to decreased costs due to a greater amount of work being done with the same effort. Monitoring programs for NRPB customers have been found to be more effectively carried out if trivial numerical data were suppressed at source. The disadvantages of data loss and therefore trends, noted, but the view of the ICRP is endorsed, i.e., that the disadvantages are not valid for an investigation level of 100 mrems/month. (UK)

25892 RADIATION STANDARDS FOR HOT PARTICLES. A Report on the Inadequacy of Existing Radiation Protection Standards Related to Internal Exposure to Man to Insoluble Particles of Plutonium and Other Alpha-Emitting Hot Particles. Tamplin, A. R.; Cochran, T. B. Washington, DC; Natural Resources Defense Council (1974). 64p.

The gravity of the public health concern as plutonium becomes a principal article of commerce in the nuclear power industry is discussed. The specific radiation protection regulations that are in force in the United States today and which are at issue are reviewed. Attention is focussed on the existing guidelines for Pu-239, but it is to be understood that it should be applied to all alpha-emitting radionuclides that meet the hot particle criteria developed in this report. Assumptions inherent in the existing radiation protection standards are presented, and those assumptions that are inappropriate when applied to insoluble alpha-emitting particulates are identified. The biological data that demonstrate that these assumptions are inappropriate when applied to hot particles are discussed. Using the biological data presented, the criteria that define a hot particle are developed. Recommendations for exposure standards for hot particles are then developed and summarized. (MHR)

Radiation Source Calibration and Standardization

Refer also to abstract 24248.

25893 METHODS AND APPARATUS FOR THE ABSOLUTE MEASUREMENT OF THE ACTIVITY OF ISOTOPES USED FOR THE CALIBRATION OF RADIOMETRIC APPARATUS. Garapov, E. F.; Gryaznov, A. N.; Denisikov, A. I.; Sobolev, Yu. P. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 20, 72-78(1973). (In Russian).

Apparatus for the measurement of the activity of isotopes by coincidence methods are examined. A method for the introduction of corrections to the self-absorption is described. A method for the preparation of the sources is discussed. The methods and apparatus discussed make it possible to measure the activity with an error of 0.5 to 2%. (tr-auth)

Shielding Calculations and Experiments

Refer also to abstracts 25860, 26102–26104, and 26168.

25894 (DP-1339) ^{252}Cf SHIELDING WITH WATER-EXTENDED POLYESTER. Stoddard, D. H. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Nov 1973. Contract AT(07-2)-1. 27p. Dep. NTIS $4.00.

Dose rates from ^{252}Cf shielded by ten mixtures containing water-extended polyester resins are calculated. The radiation properties of ^{252}Cf used in the calculations are tabulated. (auth)

25895 DESIGN OF A DOUBLE-BENT DUCT BY THE LINE-OF-SIGHT METHOD. Fiebig, R.; Yamaji, A. Atomkernenergie; 22: No. 2, 105-112(Oct 1973). (In German).

Investigations are summarized which are to be made for the design of a double-bent duct in a concrete shielding wall for γ-radiation where the weakening of the wall is to be made up by inserting slabs of iron or lead. The method of ray analysis proves to be sufficiently reliable in spite of all simplifications made. It is shown that only some of the investigations made are really important in practical cases. (GE)

25896 DESIGN OF AN ADDITIONAL SHIELDING LAYER FOR A DUCT IN A CONCRETE SHIELDING WALL. Fiebig, R.; Yamaji, A. Atomkernenergie; 22: No. 2, 113-115(Oct 1973). (In German).

Additional shield is necessary to maintain the shield effect behind a bore in a shielding wall. By means of calculations with the ray analysis method that point was determined, where the additional radiation dose amounts to 50% of the dose behind the undisturbed shielding wall and from its location the width of the additional shield is calculated and given in an analytical formula. (GE)

25897 SPECTRA OF NEUTRONS TRANSMITTED THROUGH SHIELDS OF DIFFERENT MATERIALS AND THICKNESSES. Makra, S.; Vertes, P. (Central Research Inst. for Physics, Budapest). Kernenergie; 16: No. 12, 378-383(Dec 1973).

Spectra of fission and reactor neutrons behind slabs of different materials and thicknesses were calculated on the basis of an albedo code. Spectra are presented for 5–100 cm thick shields of water, $(CH_2)_n$, graphite, aluminium, beryllium, iron, lead, concrete, $(CH_2)_n$ + boron, concrete + boron, concrete + iron, and concrete + iron + boron. (auth)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 25392 and 25912.

25898 (CONF-740110-2) EFFICIENT SOLUTION OF THE RELATIVISTIC APW SECULAR EQUATION FOR BOTH EIGENVALUES AND EIGENVECTORS. Koelling, D. D. (Argonne National Lab., Ill. (USA)). 1974. 20p. Dep. NTIS $3.00.

From international symposium on atomic, molecular, solid-state theory, and quantum statistics; Sanibel Island, Florida, USA (20 Jan 1974).

The special problems introduced into the solution of the secular equation by the inclusion of relativistic effects are discussed. A method based on the use of linear combination of RAPW's is then described for solving the secular equation. This method greatly reduces the computer time and core space required to solve the secular problem and is particularly advantageous in large systems. (auth)

25899 (COO-3071-43) NON-RELATIVISTIC CURRENT ALGEBRA IN THE N/V LIMIT. Goldin, G. A.; Grodnik, J.; Powers, R. T.; Sharp, D. H. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 18 Dec 1973. Contract AT(30-1)-2171. 77p. (UPR-22-T). Dep. NTIS $6.00.

The case of a noninteracting infinite Bose gas at zero temperature is studied in the formalism of local current algebras, using the representation theory of nuclear Lie groups. The class of representations describing such a system is obtained by taking an "N/V limit" of the finite case. These representations can also be determined uniquely from the solutions of a functional differential equation, which follows in turn from a condition on the ground state vector. Finally a system of functional differential equations is formulated for a theory with interactions, using a proposed definition of indefinite functional integration. (auth)

25900 (COO-3071-47-T) HAMILTONIAN AND GENERATING FUNCTIONAL FOR A NON-RELATIVISTIC LOCAL CURRENT ALGEBRA. Menikoff, R. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). Jan 1974. 50p. (UPR-23-T). Dep. NTIS $4.50.

The nonrelativistic current algebra with conserved current consisting of $\rho(x)$, the particle number density and $J(x)$, the flux density of particles, is studied. The Hamiltonian for any time reversal invariant system of spinless particles, interacting via a two-body interaction potential, is expressed as a hermitian form in the currents. This leads to a functional equation for the generating functional, which is the ground state expectation value of $\exp\,[i \int dx\rho(x)f(x)]$. In the N/V limit an expression for the generating functional in terms of correlation functions is given. Representations of the exponentiated current algebra which are translation invariant satisfy the cluster decomposition property and which have different Hamiltonians are shown to be unitarily inequivalent. (auth)

25901 (JINR-E2-7537) TIME EVOLUTION OF PHYSICAL SYSTEMS. Lassner, G.; Lassner, G. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

A general class of time evolutions of physical systems, the c-evolutions, will be defined. These evolutions are characterized by the property that any invariant concave functional, "entropy-like" functional, increases in time. Different physical processes are shown to be c-evolutions. (auth)

25902 (JINR-P2-7651) SOME PROBLEMS OF RELATIVISTIC DYNAMICS. Strel'tsov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

When describing the dynamics of the systems with the continuous mass and charge distribution the density values for the force, mass, and charge per unit of 4-volume were used. Some problems are discussed concerned with the covariant variation principle, covariant form of the motion equations as well as with the covariant formulation of the concentration laws. (auth)

25903 (ORO-4317-34) QUANTIZED FRICTION AND THE CORRESPONDENCE PRINCIPLE: SINGLE PARTICLE WITH FRICTION. Kan, K. K.; Griffin, J. J. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Jan 1974. 8p. Dep. NTIS $3.00.

A nonlinear time-dependent Schrödinger equation is derived by means of physical arguments and the correspondence principle to describe a quantal system acted upon by a frictional force. It involves nonlinear terms of the same type as those already derived by Kostin for the Schrödinger-Langevin problem. Exact solutions are exhibited in closed form for the case of a harmonic oscillator. They exhibit reasonable properties and support the belief that the equation proposed provides an appropriate physical description. (auth)

25904 FINITE-DIMENSIONAL PATH-SUMMATION FORMULATION FOR QUANTUM MECHANICS. Pearle, P. (Hamilton College, Clinton, New York 13323). Phys. Rev. D 8: No. 8, 2503-2510 (15 Oct 1973).

The phase-space path-summation formulation of quantum theory is reviewed. The relationships to classical mechanics, and the greater generality (as compared with the original configuration-space path-summation formulation of Feynman) are stressed. Then the formulation is extended so that one can express the transition amplitude, between states (belonging to an arbitrary basis) of a finite-dimensional quantum system (with arbitrary Hamiltonian), in path-summation form. (auth)

25905 SOME REMARKS ON THE QUESTION OF ACCURACY IN PHYSICS. Ronen, Y. (Nuclear Research Centre-Negev, Beer-Sheva, Israel). Nuovo Cim.; 18B: No. 2, 354-362(11 Dec 1973).

The inevitable inaccuracies in physics are briefly discussed, and an analytic method for their estimation is presented. It is based on the functional-analysis technique and gives upper bounds to the change of eigenvalues due to inaccuracies represented by changes in the operators of homogeneous equations. Applications of the method are illustrated by examples from reactor physics. (auth)

25906 MAXIMAL KINEMATICAL INVARIANCE GROUP OF THE HARMONIC OSCILLATOR. Niederer, U. (Univ., Zurich). Helv. Phys. Acta; 46: No. 2, 191-200(15 Aug 1973).

The largest group of coordinate transformations leaving invariant the Schroedinger equation of the n-dimensional harmonic oscillator is determined and shown to be isomorphic to the corresponding group of the free-particle equation. It can be described as a Galilei group in which the time translations have been replaced by the group SL(2,R) of projective transformations. The relation between the oscillator group and the spectrum-generating algebra of the harmonic oscillator is investigated. The relevance of the oscillator group and the group SL(2,R) for general quantum systems is discussed. (auth)

25907 NEW INTERPRETATION OF THE CLOCK PARADOX IN SPECIAL RELATIVITY. Chevalier, J. (Univ., Geneva). Helv. Phys. Acta; 46: No. 2, 161-164(15 Aug 1973).

An attempt is made to clarify the confusion about the clock paradox of special relativity by introducing a symmetrical definition of simultaneity. This definition is well adapted to the postulate of physical equivalence of inertial frames in uniform relative motion. The Langevin effect is then an immediate consequence of the nontransitivity of this simultaneity relation. (auth)

25908 COMPARISON OF FINITE-ELEMENT AND FINITE-DIFFERENCE METHODS. Key, S. W.; Krieg, R. D. pp 337-352 of Numerical and Computer Methods in Structural Mechanics. Sandia Labs., Albuquerque, NM. New York; Academic Press, Inc. (1973).

Although superficially they appear quite different, the finite-element method and the finite-difference method are closely related. The differences in their presentations can be highlighted by examining plane-wave propagation in a half space. The finite-element method starts with a variational statement of the problem and introduces piecewise definitions of the functions defined by a set of meshpoint values. The finite-difference method starts with a differential statement of the problem and proceeds to replace the derivatives with their discrete analogs. Both methods result in a set of algebraic equations relating a discrete set of variables in place of the relations in the continuous variables. The algebraic equations are remarkably similar, and provide the basis for identifying the methods as essentially similar. A historical review of the literature is also included. (3 figures) (RWR)

25909 STRICTLY ONE-PARTICLE INTERPRETATION OF NONLINEAR WAVE EQUATIONS. Kapuscik, E. (Instytut Fizyki Jadrowej, Krakow). Lett. Nuovo Cim.; 9: No. 7, 271-272(16 Feb 1974).

It is pointed out that there are no reasons for the usual quantum multiplication law in theories describing physical systems for which the Rydberg–Ritz principle is not valid. An example of such systems is illustrated by considering the wave function of a single scalar particle. (LBS)

25910 STABLE CAUSALITY OF HIGHLY MOBILE SPACE–TIMES. Osinovskii, M. E. (Inst. for Theoretical Physics, Kiev). Acta Phys. Pol.; B5: No. 1, 75-79(1974).

Each highly mobile, algebraically special space–time is shown to possess a global time function. It follows from this that these space–times are stably causal. (auth)

25911 QUANTUM-MECHANICAL WAVE EQUATION FOR TWO PARTICLES OF ARBITRARY SPIN WITH INSTANTANEOUS INTERACTION. Tam, K. C. (Kiangsu-Chekiang Coll., Hong Kong). Aust. J. Phys.; 26: No. 5, 567-573(Oct 1973).

A quantum-mechanical wave equation for two particles of arbitrary spin is derived for any instantaneous interaction. The starting point is an integral equation which is a relativistic generalization of the Schrödinger integral equation and is similar to the Bethe–Salpeter equation. The final two-particle wave equation contains the sum of the Hamiltonians of the two particles and has only one time variable. It reduces the two-particle Schrödinger equation in the nonrelativistic limit. (auth)

Quantum Field Theories

Refer also to abstracts 25343, 25368, 25370, 25375, and 25391.

25912 (IFA-FT-103-1973) DIRAC BRACKET AND THE FEYNMAN PATH INTEGRAL FORMALISM FOR SINGULAR LAGRANGIANS. Micu, M. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 26p. Dep NTIS (U. S. Sales Only) $3.50.

Dirac's prescription for quantization when the canonical variables satisfy some constraints is modified in order to have only second class constraints. This is performed by adding new constraints (equal in number with the first class constraints) which represent, with respect to the invariance under the gauge transformation, a chosen gauge. Transition to quantum scheme can be performed by replacing Poisson brackets by Dirac brackets, without imposing conditions to the physical state vectors, because finally all constraints belong to the second class. The Feynman path integral formalism in phase space is also presented, for the case when both first and second class constraints are present. (auth)

25913 (JINR-P2-7572) CAUSALITY IN THE QUANTUM FIELD THEORY WITH THE NONLOCAL INTERACTION. Ale bastrov, V. A.; Efimov, G. V. (Joint Inst. for Nuclear Resear Dubna (USSR). Lab. of Theoretical Physics). 1973. 32p. (I Russian). Dep. NTIS (U. S. Sales Only) $3.75.

In the quantum field theory with a nonlocal interaction, where nonlocality is introduced with the help of the form factors being the entire analytical functions of the order of growth of ½, it is proved that the S-matrix satisfies the Bogolubov microscopicity condition in each order of perturbation theory. (auth)

25914 (JINR-P2-7590) CALCULATION OF THE ONE-PARTICLE EXCITED STATE MASS IN THE SIMPLEST MODEL OF QUANTUM FIELD THEORY WITHOUT PERTURBATION THEORY. Zastavenko, L. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Consideration of relativistic invariance allows one to calculate the mass of the one-particle excited state in the model $g[\phi^4]_2$ without solving the problem on search for eigenvalues of the excited state equation. (auth)

25915 (JINR-P2-7647) LIENARD–WIECHERT'S POTENTIALS AND THE RELATIVISTIC LENGTH CONCEPTION. Strel'tsov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 9p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The concept of the distance (used in electrodynamics, based on the Liénard–Wiechert's potentials) which gives evidence for the conception of the relativistic length (as a space part of half difference of two 4-vectors describing the light signal distribution along some scale in the forward and backward direction) different from the conventional conception is outlined. (auth)

25916 CURRENT UNCERTAINTY IN THE RATIO OF ACTIVE-TO-PASSIVE GRAVITATIONAL MASS. Morrison, D.; Hill, H.A. (University of Arizona, Tucson, Arizona 85721). Phys. Rev. D 8: No. 8, 2731-2733 (15 Oct 1973).

The sensitivity of Kreuzer's experiment to a difference in active-to-passive mass ratios, $\Delta\eta/\eta$, is calculated on the basis of design specifications. This provides an independent means for determining the experiment sensitivity not subject to the criticisms directed toward the original evaluation. The sensitivity is found to be $(\Delta\eta/\eta)/S(0) = 1.9 \times 10^{-5}$, where S(0) is the signal recorded by the apparatus due to nonzero $\Delta\eta/\eta$. This result is in substantial agreement with the original results. (auth)

25917 IS THERE SPONTANEOUS SYMMETRY BREAKING IN GAUGE THEORIES WITH THE HIGGS-KIBBLE MECHANISM? Sucher, J.; Woo, C.H. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. D 8: No. 8, 2721-2724 (15 Oct 1973).

It is argued that gauge theories with the Higgs–Kibble mechanism do not involve the spontaneous breaking of physical symmetries. The relationships between masses and coupling constants, usually considered a manifestation of the remnant of the symmetry, can be obtained, at least in the Abelian–Higgs model, directly from renormalizability and unitarity requirements. (auth)

25918 LIGHT–CONE OPERATOR EXPANSIONS IN PERTURBATION THEORY. I. Cornwall, J.M.; Tiktopoulos, G. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. D 8: No. 8, 2675-2687 (15 Oct 1973).

With the aid of a general algorithm for expanding a given Heisenberg operator product in terms of n-particle irreducible operator products integrated over c-number Bethe–Salpeter kernels, we discuss the expansion of bilocal products near the light cone. It is shown that, to any finite order in perturbation theory, only a small number of terms in the operator-product expansion can be singular on the light cone. In particular, some of the bilocal operators which determine the scaling properties of deep-inelastic electroproduction have potential singularities determined by operator-valued Bethe-Salpeter equations involving only these bilocals themselves (plus local fields). A generalization of the light-cone Bjorken–Johnson–Low (BJL) limit is given which reveals logarithmic singularities which occur in T products but not in commutators; this BJL limit is applied systematically to Feynman graphs in another paper. As a special case, the Wilson expansion is recovered. (auth)

25919 LIGHT–CONE OPERATOR EXPANSIONS IN PERTURBATION THEORY. II. Cornwall, J.M.; Tiktopoulos, G. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. D 8: No. 8, 2687-2701 (15 Oct 1973).

A systematic investigation, in perturbation theory, is presented of the light–cone behavior of multiparticle matrix elements of time-ordered products of local fields: $\int d^4x\, e^{iqx} < \beta\, |T\psi_1(x)\, \psi_2 0 \mid \alpha >$. In the limit $q_- \to \infty$, the contribution of any single Feynman graph is of the form $q_-^{\beta}(\ln q_-)^{\gamma}$. The main result here is a rule by means of which the integers β and γ can be read off from the topology of the graph. The implications of this investigation for local field theories are organized and discussed in operator language in a companion paper. A by-product of the special methods here developed to obtain asymptotic estimates in perturbation theory is a refinement of Weinberg's theorem for the Euclidean region: the determination of the logarithmic factors in the asymptotic form of Feynman amplitudes when a set of external momenta $q_1, q_2, \ldots$ is allowed to approach infinity according to $q_i = \eta q_i'$, $\eta \to \infty$. (auth)

25920 2^+ NONET AS GAUGE PARTICLES FOR SL(6,C) SYMMETRY. Isham, C.J. (Imperial College, London, England); Salam, A.; Strathdee, J. Phys. Rev. D 8: No. 8, 2600-2609 (15 Oct 1973).

We construct an SL(6,C) gauge-invariant Lagrangian which describes a nonet of massive positive-energy 2^+ particles. Of importance for the model are the concepts of covariant constraint and spontaneous symmetry breaking. The distinguishing feature of the present theory is the set of conserved currents which generate the algebra of SL(6,C). We also present gauge-invariant and unitarity-preserving quark and meson (quark-antiquark composite) Lagrangians. (auth)

25921 PROPERTIES OF SCALING FUNCTIONS IN $g(\phi^{\dagger}\phi)^2$ FOR SMALL COUPLING. Menotti, P. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). Phys. Rev. D 8: No. 8, 2496-2503 (15 Oct 1973).

We derive some properties of the scaling functions of the $g(\phi^{\dagger}\phi)^2$ theory when canonical scaling is realized by a Gell–Mann–Low zero of the function $\beta(g)$. We examine in particular the small values of g (both positive and negative). For $g \to +0$ the longitudinal scaling function cannot reduce to the free–field one, and under a regularity assumption a bound set on the $\omega \to 0$ behavior of the longitudinal scaling function for small $|g|$ which corresponds to a Regge singularity at $J = 0$ or higher. (auth)

25922 UNITARITY IN GAUGE THEORIES WITH NONLINEAR GAUGE CONDITIONS. Hsu, J.P. (The Center for Particle Theory, The University of Texas at Austin, Austin, Texas 78712). Phys. Rev. D 8: No. 8, 2609-2613 (15 Oct 1973).

We consider the Abelian gauge theories in which the transverse and the longitudinal photons are coupled. The unitarity relation holds because the unwanted absorptive part of the amplitude due to this coupling is canceled by the fictitious particle. It is pointed out that, by introducing the Lagrange multiplier, one can see the cancellations for all orders in perturbation expansions by looking at the equation of motion for the Lagrange multiplier. The possible implication of this on the massless Yang–Mills fields is indicated. (auth)

25923 ACTION PRINCIPLE AND NONLOCAL FIELD THEORIES. Marnelius, R. (Institute of Theoretical Physics, Fack, S-402 20 Göteborg 5, Sweden). Phys. Rev. D 8: No. 8, 2472-2495 (15 Oct 1973).

Lagrangian densities are introduced for nonlocal field theories, which make the application of the action principle possible. The action principle is then applied to classical and quantum nonlocal field theories. General formulas for conserved densities are derived by use of a generalized variation method, under the assumption of c–number variations. These formulas are also applied to a particular model due to Kristensen and Møller. The charge and energy–momentum vector are, thereby, shown to be equal to the expressions given by Pauli, which he derived by other means. This model is also quantized by use of the Yang–Feldman method. But as this method leads to a noncanonical quantization, the above derived quantities are in general no longer conserved. This is due to the fact that the assumption of c–number variations essentially restricts the quantization to a canonical one. The action principle with q–number variations is therefore considered. Thus new integral conserved quantities are derivable. However, one also gets a general consistency condition for the above model as well as for all other similar models. The fulfilment of this condition is required by (i) stationarity of the total action and (ii) uniqueness of the integral conserved quantities. It is also a necessary condition for the existence of a unitary S operator. The Kristensen–Møller model is shown to violate the above condition, and is therefore not consistent. (auth)

25924 SCATTERING THEORY IN A MODEL OF QUANTUM FIELDS. I. Albeverio, S. (Department of Physics, Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). J. Math. Phys. (N.Y.) 14: No. 12, 1800-1816 (Dec 1973).

We study a model of quantum field theory with "Yukawa–like" interaction $\lambda \int \Phi^{+}_{b}(x)\, \Phi^{-}_{b}(x)\, \Phi_{a}(x)dx$ between nucleons (b) and mesons (a). It is a version of Nelson's model with relativistic kinematics and has been renormalized by J. P. Eckmann. The infinite mass renormalization is a power series in λ^2, chosen in such a way as to confer on the renormalized Hamiltonian $\hat{H}$ the correct relativistic single particle spectrum. Physical one nucleon states are given by a modified Friedrichs one–particle expansion constructed by Eckmann. The Heisenberg picture's creation–annihilation operator for dressed nucleons and mesons are studied in detail, as a preparation for the construction of the correspondent asymptotic fields, carried through, in this paper, for the mesons fields in general and for the nucleon fields on particular states (the general case is treated in the second paper of this series). Analytic properties of the interacting fields in λ are proved and commutation relations of the asymptotic fields are established. Moreover, strong asymptotic states are constructed as well as isometric wave operators. Finally some reduction formulas for the meson–nucleon scattering are derived. (auth)

25925 SOME THEOREMS IN AXIOMATIC QUANTUM THEORY. Todorov, T. S. (Inst. of Nuclear Research and Nuclear Energy, Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 10, 1309-1310 (1973). (In Russian).

In the quantum field theory the quantum field is called irreversible if each boundary operator B is such that $(B\, \varphi\, (x)\, f, g) = (Bf, \varphi^{*}\, (x)\, g)$. A new exposition of this fact is given. In the exposition the Borchers assumption that is the boundary operator B weakly commutates with the field φ (x), then B commutates with all the representation operators of U (a, Λ) of Poincare groups. This expression was demonstrated in the case $U_{a,\Lambda} = U_{a,\Lambda} = U_{a}$. (JSR)

25926 EQUIVALENCE THEOREMS FOR EFFECTIVE LAGRANGIANS. Rouet, A. (Centre de Physique, Marseille). Nucl. Phys.; B68: No. 2, 605-614(1974).

Two combinatorial theorems relevant to Zimmermann's formulation of Lagrangian perturbation theory are proved in view of application to problems concerning symmetry breaking. (auth)

25927 SPONTANEOUS CHIRAL SYMMETRY-BREAKING AND PARTIAL DIFFERENTIAL EQUATIONS. Jegerlehner, F.; Schroer, B. (Freie Univ., Berlin). Nucl. Phys.; B68: No. 2, 461-495(1974).

Using a modified normal-product quantization as suggested by Lowenstein and Zimmermann which incorporates B. Lee's resummation problem from the very beginning into the BPHZ renormalization, the derivation of partial differential equations of the Callan-Symanzik type is discussed. In addition to the renormalization group and the Callan-Symanzik equation which are the appropriate differential-equations for the high energy limit (the overall zero-mass preasymptotic theory), a third partial differential equation is found which allows discussion of the spontaneous broken symmetry limit $m_{\pi} \to 0$ to all orders of the new perturbation theory. In this treatment there is no necessity for loop summation; all the interesting questions are delegated to ordinary perturbation problems. (auth)

25928 INTRODUCTION TO SPECIAL RELATIVITY. Resnick, R. New Delhi; Wiley Estern Pvt. Ltd. (1971). 225p.

The theory of special relativity is presented as an introductory part of modern physics. "Experimental background of the theory of special relativity", "relativistic kinematics", "relativistics dynamics" and "relativity and electromagnetism" are covered. More emphasis was laid on the aspect of physical interpretation of this complex principle, so that it is made easy to comprehend. Numerous illustrations, tables, numerical examples, etc. are included. (INIS)

25929 LAGRANGIANS FOR MASSIVE, ARBITRARY SPIN FIELDS. Foster, G. H. (Clemson Univ., SC). Acta Phys. Pol.; B5: No. 1, 143-144(1974).

Explicit Lagrangians for massive, arbitrary spin fields are developed. These Lagrangians lead, by the usual variation, to the field equations and subsidiary conditions for fields describing massive particles of arbitrary spin. (auth)

25930 INTERPRETATION OF THE IMAGINARY PART OF BOSON ENERGY IN STRONG EXTERNAL FIELD. Mostepanenko, V. M. Vestn. Leningrad. Univ., Fiz., Khim.; No. 3, 137-139(Aug. 1973). (In Russian).

The problem of interpretation of the imaginary part Im ε of boson energy in the strong external field has been considered. Both the cases of vector and scalar external fields are examined. It is shown that Im ε cannot be interpreted as the boson pair creation probability due to necessity of introduction of the indefinite metric at (auth)

25931 QUANTIZATION OF THE YANG–MILLS FIELD IN THE NULL-PLANE FRAME. Tomboulis, E. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., D; 8: No. 8, 2736-2740(15 Oct 1973).

The massless Yang-Mills field is quantized in the null-frame gauge $A^{a}_{-} = 0$, and Feynman rules are derived. (auth)

25932 COMMUTATIVITY AND CAUSAL INDEPENDENCE. De Facio, B. (Iowa State Univ., Ames); Taylor, D. C. Phys. Rev., D; 8: No. 8, 2729-2731(15 Oct 1973).

We show that the original question concerning the relation between causal independence and local commutativity by Haag and Kastler remains open. Ekstein has given an infinite-dimensional reducible example which shows that causal independence neither implies local commutativity nor necessarily follows from local commutativity, and we supply a finite-dimensional example of this interesting fact. (auth)

25933 CHARGED VACUUM IN OVER-CRITICAL FIELDS. Rafelski, J.; Mueller, B.; Greiner, W. (Univ., Frankfurt am Main). Nucl. Phys.; B68: No. 2, 585-604(1974).

The concept of over-critical fields, i.e. fields in which spontaneous, energy-less electron-positron pair creation may occur, is discussed. It is shown that only a charged vacuum can be a stable ground state of the overcritical field. The time-dependent treatment confirms previous results for the cross sections for the autoionizing positrons. The questions in connection with the classical Dirac wave functions in over-critical fields are extensively discussed in the frame of the self-consistent formulation of QED including the effects of vacuum polarization and self-energy. (auth)

25934 FUNCTIONAL TECHNIQUES AND A NONFORMAL PROOF OF THE EQUIVALENCE THEOREM IN LAGRANGIAN QUANTUM FIELD THEORY. Blasi, A.; Collina, R. (Univ., Genoa). Nucl. Phys.; B68: No. 2, 443-451(1974).

A proof is given of the equivalence theorem in Lagrangian quantum field theory employing functional techniques and a regularization prescription which yields finite results at each order of the perturbation expansion. (auth)

25935 HAMILTONIAN DYNAMICS OF FIELDS IN FRONT FORM. Hsu, J. P. (Rutgers–, The State Univ., New Brunswick, NJ). Nucl. Phys.; B68: No. 1, 66-67(1974).

A new approach for constructing the Hamiltonian dynamics for a coupled Dirac field $\psi(x)$, quantized on the light-front $t + z = 0$, in which the momentum representation of fields is used to obtain the anti-commutator for $\psi(x)$ and its momentum conjugate $\pi(x)$. Aside from the usual definition of $\pi(x)$, the Hamiltonian, the anti-commutators and the Hamiltonian equations of motion, a subsidiary condition is needed for $\psi(x)$ to make the front-form dynamics consistent and valid in any inertial frame. By treating all components of $\psi(x)$ in the same manner and retaining the subsidiary condition, the theory is made simple and elegant. In contrast to the infinite-momentum-frame approach, there is no non-covariant term in the Hamiltonian and the propagator in our approach. The resultant Feynman rules make the equivalence of the scattering matrices between the front-form dynamics and the conventional dynamics become apparent. The difference between the two forms of dynamics is also discussed. (auth)

25936 FORMULATION OF SPONTANEOUS BREAKDOWN IN THE PATH–INTEGRAL METHOD. Matsumoto, H.; Papastamatiou, N. J.; Umezawa, H. (Univ. of Wisconsin, Milwaukee). Nucl. Phys.; B68: No. 1, 236-254(1974).

The problem of formulating spontaneous breakdown of symmetries is examined in the path-integral framework: since different solutions of the field equations correspond to different boundary conditions, the possibility of different boundary conditions must be incorporated in the generating functional itself. A modification of the generating functional is proposed that provides the required flexibility that can lead to different solutions. The formalism is applied to a model of scalar complex fields with invariance under phase transformations of the first kind and derive Ward–Takahashi identities and the Goldstone theorem. (auth)

Gravitation and General Relativity

Refer also to abstract 25057.

25937 AN EXACT SOLUTION OF A SCALAR–TENSOR THEORY OF GRAVITATION. Ihrig, E.; Sen, D.K. (Department of Mathematics, University of Toronto, Toronto M5S, 1A1, Canada). J. Math. Phys. (N.Y.) 14: No. 12, 1933-1934 (Dec 1973).

An exact, closed–form, static spherically symmetric solution to the field equations of a scalar–tensor theory is given. This is compared with the series solution given previously. Also, an analysis is made of the geodesics of the theory. (auth)

25938 GRAVITATION AND THE NEW IMPROVED ENERGY–MOMENTUM TENSOR. Ohanian, H.C. (Rensselaer Polytechnic Institute, Troy, New York 12181). J. Math. Phys. (N.Y.) 14: No. 12, 1892-1897 (Dec 1973).

We give precise definitions of the weak and strong principles of equivalence and show that the new gravitational theory based on the improved energy–momentum tensor of Callan, Coleman, and Jackiw [Ann. Phys. (N.Y.) 59, 42 (1970)] satisfies both of these principles. As a consequence of the equality between the 4–momentum given by the canonical energy–momentum tensor and the "momentum" given by the pseudotensor that is the source of gravitation, the weak principle is also shown to hold in more general Einstein theories. Investigation of the interactions of a scalar field in the new gravitational theory shows that, besides the familiar long range interaction, there exists a new short range gravitational interaction between any scalar field and other matter. (auth)

25939 FOCUSING OF GRAVITATIONAL RADIATION. Ohanian, H.C. (Rensselaer Polytechnic Institute, Troy, New York 12181). Phys. Rev. D 8: No. 8, 2734-2735 (15 Oct 1973).

Under the assumptions that gravitational radiation is emitted by a pointlike source and focused by passage through the exterior or interior gravitational fields of a massive object, the intensity gain is shown to be of the order of $GM/\lambda c^2$ over a diffraction beam of small angular width. (auth)

25940 TETRAD THEORY OF GRAVITATION IN A SPACE OF ABSOLUTE PARALLELISM. Tunyak, V. N. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 5, 98-104(1973). (In Russian).

The progressive formulation of the basic thesis of the tetrad theory of gravitation in a space of absolute parallelism U_4 is given. Its application to the calculation of the observed heliorelativistic effects is examined. It was shown that with the characteristics of the tetrad theory of gravitation there is a choice in the source of the gravitational field of the total canonical tensor of the energy-momentum of the nongravitational matrix and a single-valued determination of the complete energy-momentum of the gravitational field and the nongravitational matrix. The conditions imposed on the tetrad theory of gravitation by the correspondence principle with the Newtonian theory and the Lorentz invariant theory of the nongravitational matrix were determined. The expressions were obtained for the heliorelativistic effects of light deflection, signal lag, and perihelion displacement, distinguishable from the analogous predictions of the general relativity theory and agreeing with the observations with some choices of the specific "teleparallel" constants characterizing the deviation of the space-time geometry U_4 from the Riemann-Schwarzschild geometry of the general relativity theory. A brief review is also given of a series of studies on the tetrad theory of gravitation and particularly the fallacy of the Pellegrini-Plebanski approach was noted. (tr-auth)

25941 SOLUTION OF THE EQUATIONS GOVERNING THE COUPLED EMISSION OF GRAVITATIONAL AND ELECTROMAGNETIC RADIATION. Johnston, M. (Joseph Henry Labs., Princeton, NJ); Ruffini, R.; Peterson, M. Lett. Nuovo Cim.; 9: No. 6, 217-223(9 Feb 1974).

Some of the analytic properties of the system of differential equations governing the emission of electromagnetic and gravitational radiation due to the radial infall of an unchanged particle of mass m in a Reissner-Nordstrom metric are examined, and the integration technique is amplified. (LBS)

25942 CROSS SECTIONS OF A CYLINDRICAL ANTENNA FOR GRAVITATIONAL WAVES. D'Anna, E.; Pizzella, G.; Trevese, D. (Univ., Lecce, Italy). Lett. Nuovo Cim.; 9: No. 6, 231-234(9 Feb 1974).

The possibility is considered that if gravitational waves exist they might generate, in a cylindrical antenna, longitudinal vibrations other than axial (or in addition to them). The cross section of a gravitational wave with a cylinder vibrating in such a radial mode is computed and a comparison is made with that for axial vibrations. (LBS)

25943 EINSTEIN'S CAUSALITY AS A CONSEQUENCE OF EQUAL-TIME COMMUTATION RELATIONS IN SOME SOLUBLE MODELS. de Mottoni, P. (Consiglio Nazionale delle Ricerche, Rome); Salusti, E. Ann. Inst. Henri Poincare, Sect. A; 18: No. 3, 241-250(1973).

The evolution of the commutation (anticommutation relations given at a fixed time is shown to give rise to space like (anti commutation properties for approximate fields governed by a differential equation. (auth)

25944 STRONG GRAVITATION. Papyrin, A. F. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 5, 528-533(1973). (In Russian).

Within the framework of the general theory of relativity a model was constructed of the strong interaction of particles under the assumption that with the metric tensors in the microcosm a tensor of the second rank $f_{\mu\nu}$ appears describing particles with spin 2 with $m \neq 0$. The size of the interaction constants which are close to the size of the strong coupling factors is evaluated. The hypothesis of vector dominance was obtained from purely geometric considerations. (tr-auth)

25945 POSSIBILITY OF THE PHYSICAL INTERPRETATION OF STATIC POLYCENTRIC SOLUTION OF THE EINSTEIN EQUATIONS. Galkin, S. L. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 14: No. 5, 542-546(1973). (In Russian).

In connection with the Curson solution and other solutions the concept was expressed that two collapsing objects do not attract. (tr-auth)

25946 ISOMETRIC MOTION OF A CHARGED FLUID IN THE EINSTEIN–MAXWELL THEORY. Woolley, M. L. Proc. Roy. Soc. (London). Ser. A; 336: No. 1606, 273-284(5 Feb 1974).

It is shown that in the Einstein-Maxwell theory a class of four-dimensional charged fluid space-times exists, with nonzero fluid pressure, satisfying the conditions that the fluid motion is isometric, the dual of the electromagnetic field tensor has no projection in the direction of a Killing vector—equivalent to the condition that in a static space time the local field of an observer moving with the fluid is purely electric—and the ratio of charge to mass is constant. For the case of a diagonal static metric it is seen that a group of quasiconformal transformations may be determined which leaves the field equations unchanged. This may be used to obtain a full solution of the field equations, in three independent variables, from a given solution in one independent variable. A spherically symmetric solution of this kind is obtained which is seen to be expressible in terms of hypergeometric functions. An interesting aspect of this is that the charge/mass ratio can only have discrete values depending on the eigenvalues of a linear boundary-value problem. (auth)

25947 PROPAGATION AND BROADENING OF PULSES IN WEAKLY IRREGULAR MEDIA. Uscinski, B. J. (Cambridge Univ., Eng.). Proc. Roy. Soc. (London), Ser. A; 336: No. 1606, 379-392(5 Feb 1974).

The Weizsäcker–Williams method (Mat.-fys., Meddr.; 13: 4 (1935)) of virtual quanta is extended to the domain of gravitational encounters, and a correlation is set up between collision problems and the corresponding interaction of gravitational radiation. In the local rest frame of a relativistic test particle the gravitational field of a Schwarzschild mass consists predominantly of a momentum of plane-fronted gravitational waves. This equivalent momentum is analyzed by Fourier analysis and the scattering of each frequency component, virtual quanta, by the test body is considered. The scattering by the long-range Newtonian-type field of a point particle is described by the analog of the Rutherford cross section. The escape of this scattered flux to infinity, suitably transformed, gives the radiative loss of gravitational energy by a rapidly moving particle. The radiation spectrum and total energy radiated in a distant bremsstrahlung encounter are computed as an example. (auth)

REACTOR TECHNOLOGY AND REGULATION

25948 (RDT-STATUS-1-74) BIMONTHLY STATUS REPORT: RDT STANDARDS. Summary as of January 31, 1974. (USAEC Division of Reactor Development and Technology, Washington, D.C.). 20 Feb 1974. 58p. RSO.

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 24673, 26177, 26279, 26281, 26282, 26312, 26319, 26320, 26322, 26326–26330, 26335, 26336, 26339, 26340, 26350–26353, 26355, and 26390.

25949 (ANCR-1127) RELAP4: A COMPUTER PROGRAM FOR TRANSIENT THERMAL-HYDRAULIC ANALYSIS. Moore, K. V.; Rettig, W. H. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Dec 1973. Contract AT(10-1)-1375. 151p. Dep NTIS $7.60.

RELAP4 is a digital computer program, written in FORTRAN IV, developed to describe the behavior of water-cooled nuclear reactors subjected to postulated transients such as those resulting from loss of coolant, pump failure, or power excursions. The program calculates fluid conditions such as flow, pressure, mass inventory, and quality; thermal conditions such as surface temperatures, temperature profiles, and energy distributions; and heat fluxes in power generating and dissipating elements. The program also calculates reactor power, decay heat, and reactivity. In addition to describing transients in boiling-water and pressurized-water reactors, the program is sufficiently versatile to describe transients in experimental thermal-hydraulic systems. The RELAP4 user must define the geometric features of the system to be analyzed as well as an appropriate set of initial conditions. RELAP4 then solves an integral form of the fluid conservation and state equations applied to each user-defined control volume. Currently, the number of these control volumes is limited to 75 and the number of junctions (flow paths) between volumes is limited to 100. By simply increasing the array sizes, these limits could be raised, if necessary, until the capacity of the particular computer is reached. RELAP4 source decks are available in double precision (EBCDIC) versions. Special timing and input-output routines are available and used by the RELAP4 program for the IBM 360 systems. Some of these routines are necessary and, if other computers are used must be rewritten for those computers. Sample problems have been run on the IBM 360/75 computer. (37 references) (auth)

25950 (CEA-CONF-2536) BEHAVIOR OF ZIRCALOY–UO_2 FUEL ELEMENTS WORKING AT LOW TEMPERATURE (300°C). UO_2 Clad Interaction: ELO Test. Chagrot, M.; Ringot, C.; Vidal, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91, Gif-sur-Yvette (France)). [nd]. 9p. (CONF-731004-5). Dep. NTIS (U.S. Sales Only) $3.00.

From international conference on nuclear fuel performance; London, UK (15 Oct 1973).

The ELO tests had three purposes: determine the failure mechanisms and derive possible countermeasures; select the more favorable cladding material; and measure the strains resulting from power increases during normal reactor operation. The tests examine the failure characteristics of typical water-cooled reactor fuel elements. (auth)

25951 (CEA-N-1665) DRY-OUT MODEL IN A TWO-PHASE FLOW. Sursock, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91, Gif-sur-Yvette (France). Dept. de Physique des Reacteurs et de Mathematiques Appliquees). Oct 1973. 42p. (In French). Dep. NTIS (U.S. Sales Only) $4.25.

The dry-out of the liquid film in a two phase flow limits the performances of water reactors. A model describing this phenomenon is proposed. The model is based on calculations of the flow rate in the film and takes into account evaporation, liquid entrainment and droplet deposition. The calculations are in good agreement with experiments for uniform and nonuniform flux. (10 references) (FR)

25952 (CONF-730942-P3, pp vp Paper G 1/11) STRESS ANALYSIS OF PRESSURE VESSEL NOZZLES. Putzeys, J.; Reynen, J.; Blanckenburg, J.; de Windt, P. (EURATOM, Ispra, Italy). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The stress analysis of the main nozzles of pressure vessels represents a three dimensional problem, both from the point of view of geometry and of loading. The two dimensional analysis i.e., nozzle on a flat plate or nozzle on a sphere is an approximation even when Fourier type of finite ring elements are used and the nominal membrane stress far away from the nozzle is developed in Fourier series, although for axisymmetrically reinforced BWR nozzles good results are obtained. The trend in the stress analysis of pressure vessel nozzles is therefore to treat the problem as a three dimensional one, also in view of the analysis of cracked nozzles, according to the LFM concept. A study on the accuracy of three dimensional analysis, using the finite element program system BERSAFE by comparing results obtained for different three dimensional meshes as well as with published two dimensional results and experimental data is described. The three dimensional meshes of the nozzle geometry are generated by the program EURCYL, using parabolic isoparametric solid finite elements. These elements have shown to be extremely efficient in reducing the number of degrees of freedom and they allow for a correct representation of fillet radii. In order to determine the thermal stresses due to coolant temperature variations, thermal analyses have been carried out by means of the finite element program FLHE. Results of two and three dimensional calculations for temperature and thermal stresses are compared. (auth)

25953 (CONF-730942-P3, pp vp Paper G 5/2) STANDARDS AND SPECIFICATIONS FOR SELECTING OPTIMUM NUCLEAR REACTOR PRESSURE BOUNDARY METALS: A PARTICIPANT'S REVIEW OF USA APPROACHES AND NEEDS. Steele, L. E. (Naval Research Lab., Washington, DC). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The pressure boundary materials for nuclear reactors must be selected for highest assurance of integrity over the anticipated lifetime of the system. Such assurance requires standards and specifications which are developed for optimized strength and toughness relationships not only at initial system startup but over system lifetime as well in spite of service environmental effects. Experience in the study of the fracture of ferritic materials used for pressure components of water reactors before and after radiation exposure has led to certain criteria, codes, and standards for assuring component integrity. Also, guides have been developed for selecting austenitic stainless steel components for advanced reactors again with priority upon optimizing the service reliability of components. The status of such standards and specifications developments in the USA as well as pertinent experimental research studies are reviewed to reflect the aim of assurance of structural integrity in the as-fabricated component considering the best projections of environmental effects as well as initial properties. Data developed in the study of irradiation effects on ferritic pressure vessel steels are reviewed as an example of the use of standards to control metal response to service environment. In this case, through specifications which limit certain component elements, especially copper and phosphorus, enhanced resistance to nuclear radiation damage is assured. Experimental data upon which the specified limits were based are cited. Also, experimental observations which demonstrate similar needs for the austenitic stainless steels being selected for advanced reactors are reviewed with suggestions for needed basic and applied research to permit similar specifications and standards. (auth)

25954 (CONF-730942-P3, pp vp Paper H 3/7) LIDS FOR A PRESTRESSED CONCRETE PRESSURE VESSEL FOR LIGHT WATER REACTORS. Bindseil, P.; Dietrich, R.; Eick, M. (Fried. Krupp GmbH, Essen). 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Increasing problems of machining and transportation of future thick-walled steel vessels for light water power reactors led to the development of PCPV design concepts for on-site construction, that means easy transport and erection of the different components without expensive devices on the site. Following a survey on known designs for lids, there is given a definition of the task for the development of design concepts. Accentuation is on criteria which appear essential: automation, machining and handling. Principles of design and general properties of the lid structures are described. An example is given for the solution of the design problem of transmitting the forces of the lid being induced by inner pressure of the vessel into the wall of the prestressed concrete pressure vessel. With this design it is not necessary to remove each single part of the device for transmitting the forces before removing the lid-body. Furthermore, the design of a jointing is described which allows a reduction of the length of the elements for transmitting the forces of the lid. For critical assessment of the lids, a stress analysis is prerequisite. A detailed analysis is necessary as loadings have locally extremely high values and also due to the space structure of the lids. Its purpose is to locate points with peak stresses. Numerical calculations for stress and strength analysis were executed by a computer program being able to analyze linear elastic systems by the finite element method. These calculations gave results on the distribution of deformations, normal and shear stresses within the structure of the lids as a function of radius and height of the lid. (auth)

25955 (CONF-730942-P3, pp vp Paper H 3/9) SCANDINAVIAN PCRV DEVELOPMENT: PRESENT STATUS AND PLANNED WORK, 1973-1975. Menon, S. (Aktiebolaget Atomenergi, Studsvik, Sweden); Rasmussen, I.; Tarandi, T.; Kraemer, W. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Previous papers reported tests performed at Studsvik, Sweden, on a large scale integral model of the proposed design of a PCRV for a BWR. The second phase of development consisted of a study to assess the feasibility of BWRs with PCRVs from the technical and economic points of view as well as to locate and enumerate aspects of the Scandinavian design that were considered to require practical verification. The reference design of a 900 MW(e) BWR with PCRV which was the basis of the feasibility study was not significantly different from the design presented at Geneva 1971. The vessel has a removable lid, a cold liner with removable insulation, integrated main circulating pumps, and a conventional totally enclosing pressure suppression containment. The important new features introduced have been steam and water penetrations in the barrel of the vessel, external hoop prestressing, and a proposal for liner ventilation. The experimental program consisted of the simulation of various extreme accidents such as the sudden loss of insulating gas and depressurization resulting from a steam rupture. The programme concluded with a cold pressure test to 2.5 times the design pressure (215 ata). The study confirmed the feasibility of the Scandinavian PCRV design for a BWR and proposed a program of tests of a verifying nature on a number of points in order to provide the detail evidence to support an investment in a nuclear application. This proposed verification program consists of tests on the liner ventilation system, failure tests in special rigs on the lid design and perforated bottom slab, vibration tests on the insulation casing and radial pipe assemblies, manufacturing tests on the bottom slab, corrosion and radiolysis tests on the insulation as well as design of an integral model of the vessel design. The technical results of the experimental work and the feasibility study performed during the second phase of development are described. The present status of the various experimental tasks that have been undertaken in the verification program is reported. (auth)

25956 (CONF-730942-P3, pp vp Paper H 4/3) ULTIMATE LOAD BEHAVIOR OF PCRV TOP CLOSURES. Theoretical and Experimental Investigations. Andersen, S. I.; Ottosen, N. S. (Danish Atomic Energy Commission, Risoe). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Ultimate load tests on PCRV top closure models (scale 1:11 of the present prototype vessel) are under execution by the Danish AEC Research Establishment Risö, as part of the joint Scandinavian development work on prestressed concrete vessels for light water-reactors. The primary scope of the test program is to investigate the influence from different design parameters (depth to span ratio, steel flange, and bonded reinforcement) upon the failure mode and ultimate load capacity of PCRV closures, as designed for the Nordic PCRV prototype. The test facility, situated at Risö, is a steel pressure vessel, designed for a max. hydraulic pressure of 450 bar. The closure models are placed in the vessel, and the support and loading conditions of the prototype vessel top-closure are simulated. The results from the first test series (without bonded reinforcement) are presented and compared with linear-elastic finite element calculations, where cracking of the concrete is taken into account. The study of the failed models shows that a load carrying dome-structure supported by the steel flange is formed at higher pressures. The failure mechanism can be explained as failure of the dome near the supporting steel flange. A significant result is the very high failure loads observed. The ultimate load of the extremely low model LM-1 was 400 bar corresponding to 4.8 times the prototype design pressure. The thickness of LM-1 was selected as a lower value than that necessary to fulfill relevant code requirement for the operational conditions of the PCRV. A second model LM-2 designed according to operational requirements has been brought to even higher pressures without indications of impending failure. The ultimate failure is abrupt, but warning is given by surface cracks and progressive deformations. Comparison with the calculations show that the crack formation can be predicted satisfactorily even up to failure load. At loads exceeding approximately half the failure load, the calculated strains (plasticity is not taken into account) do not agree with strain values measured. However, due to the reliable prediction of the crack pattern, the dome forces calculated are supposed to approximate the real forces reasonably. Using Mohrs failure criterion, taking into account the triaxial compression stress state in the dome structures, the calculated failure load gives a good approximation to the observed failure load. The most significant are the following: (a) The very high ultimate load of unreinforced closures (greater than 4.8 times design pressure). (b) The final failure is abrupt, but warning is given by progressive deformations. (c) Linear elastic finite element calculations, where cracking is taking into account, predicts the observed crack pattern reliable. (auth)

25957 (CONF-730942-P3, pp vp Paper H 5/3) INVESTIGATION OF THE PROBLEMS OF A HOT LINER IN A PRESTRESSED CONCRETE REACTOR PRESSURE VESSEL. Meyer, J.; Schutzbach, H. (Fried. Krupp GmbH, Essen). 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Pressure vessels of prestressed concrete construction can be used as reactor pressure vessels provided the load-bearing concrete is sufficiently protected from the heat released in the reactor core. While the problem of thermal insulation has been satisfactorily solved in different ways for gas-cooled reactors, the possible solutions to the problem in the case of boiling-water and pressurized-water reactors are still in an experimental stage. One of the insulations undergoing tests at present consists of three major components. The interior of the reactor is enclosed by a hot liner of austenitic steel plate. This is followed by a heat-insulating layer consisting of a material of high compressive strength which is separated from the load-bearing concrete by a cold liner of steel plate. The hot and cold liners are firmly connected to each other by studs anchored in the concrete. Cooling pipes welded to the cold liner remove the heat penetrating the insulation. Owing to the good thermal conductivity of the plate and the relatively small amount of heat transmitted to it, the thermal stresses set up in the cold liner are of no significance. Structurally the cold liner represents a second sealing envelope. The problems of the hot liner are discussed. During the start-up and shut-down of a reactor, the hot liner is subjected to a temperature change of approximately 300 deg. K. Since thermal expansion is restricted, thermal stresses are set up which by far exceed the yield point and therefore lead to plastic deformations. The plastic deformations of the material are calculated. The changes in shape occurring in the cylindrical portion of the pressure vessel upon cooling down of the liner and the resultant flexural strains are analyzed. The deformations occurring during cooling down with the vessel subjected to internal pressure and when the vessel is relieved of internal pressure are compared with each other. The computations are based on assumptions derived from the theory of plasticity. For the purpose of verifying the calculated results, measurements were made on different full-size segments of a liner model in order to determine what changes in shape the hot liner undergoes upon slight separation from the insulating layer in the cold state, following a thermal cycle. The results give an idea of the plastic flexural strains occurring in the plate. Apart from the deformations, the stability of the liner is of interest. The buckling behavior of the panels of steel plate demarcated by the studs is difficult to assess by way of computation, and tests are therefore of particular importance. Using the same liner models, long-time tests were carried out. The specimens were subjected to a two-axial thermal stress condition and are intended to help in determining the maximum permissible number of load cycles. (auth)

25958 (TID-26535) INVESTIGATION OF FAILED PIPE NIPPLES LACBWR CORE SPRAY COOLING SYSTEM. Final Report. Burghard, H. C. Jr. (Southwest Research Inst., San Antonio, Tex. (USA)). 6 Nov 1973. 30p. Dep. NTIS $3.50.

Inspection of the LACBWR core spray cooling system during the April 1973 outage revealed the failure of seven ¼-inch, Type 304 stainless steel pipe nipples. These nipples formed the connection between a Socklet fitting and a hexagonal threaded coupling. An angle valve with ¼-inch NPT male inlet was threaded into the other end of the hexagonal coupling. A total of 72 similar assemblies are incorporated in the system. One end of one of the failed nipples was submitted to SwRI for metallurgical evaluation. The part of the nipple furnished was contained within the hexagonal coupling which had been connected to the nipple in the original installation. Prior to the initiation of the metallurgical examination of the failed nipple, the decision was made by Dairyland Power personnel to replace the nipple-coupling assembly with a single machined fitting. Three sample replacement fittings were also submitted to SwRI for metallurgical evaluation. (auth)

25959 (WASH-1285) REPORT ON THE INTEGRITY OF REACTOR VESSELS FOR LIGHT-WATER POWER REACTORS. (USAEC Advisory Committee on Reactor Safeguards, Washington, D.C.). Jan 1974. 96p. Dep. NTIS $7.00.

Information on light water power reactor pressure vessel integrity is presented concerning construction practices, possible modes of vessel failure, operational considerations, and pressure vessel failure statistics and failure probabilities. (DCC)

25960 CONFIRMATORY MEASUREMENTS DURING RELIEF VALVE TESTS. Pohl, E.; Rupp, W. (Kraftwerk Union AG, Grosswelzheim, Ger.). Atomwirt., Atomtech.; 18: No. 12, 590-592(Dec 1973). (In German).

From Reactor Meeting; Karlsruhe, Ger. (10 Apr 1973).

Fifty-three blowdown tests have been carried out in order to verify and confirm the modifications made in the pressure relief system and in the pressure suppression chamber after the malfunction incident. A critical analysis of the tests has shown that these changes have led to significant improvements: good opening times of the valves, safe operation of the steam pre-admittance system, sufficiently low pressure values during the blowdown process, even in the case of failure of the pre-admittance system and steady-state condensation. (GE)

25961 FUEL COST EVALUATION FOR LIGHT WATER REACTORS. Roberts, J. T.; Krymm, R. (International Atomic Energy Agency, Vienna). pp 191-210 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

Nuclear fuel cycle costs are divided into six categories and examples of the amounts and timing of the corresponding payments and credits are given. The categories are natural uranium purchases and credits, plutonium credits, conversion costs and credits, isotopic enrichment costs and credits, fabrication costs, and reprocessing and reconversion. Mathematical expressions are developed and numerical examples are given for calculation of present-worth-levelized fuel cycle costs, broken down by category and into direct and indirect costs. The examples include equilibrium fuel batches and non-equilibrium multiple-batch cases. Levelized fuel cycle working capital requirements, including fuel in-core and out-of-core, are calculated for a multi-region light-water power reactor. (auth)

25962 FORSMARK SETS SCENE FOR ECOLOGY STUDY. Energy Int.; 11: No. 2, 16 (Feb 1974).

Sweden's largest nuclear power station on the Baltic coast is at Forsmark, due for service in 1978. The two 900 MW(e) ASEA-ATOM boiling water reactors will place a heavy demand for cooling water from the sea and will draw cooling water from the Asphalls firth. The warm water will be discharged through a long tunnel on the sea bed. A biotest lake will be formed by construction of a dam between several small islands and will allow study on the effects of prolonged discharge of warm water on marine flora and fauna. Plans for additional nuclear power stations are described. (MCW)

25963 FUEL ASSEMBLY FOR A NUCLEAR REACTOR AND A NUCLEAR REACTOR CORE COMPRISING SUCH FUEL ASSEMBLIES. Marstrand, J. (to Atomenergikommissionen). US Patent 3,787,285. 22 Jan 1974. Priority date 13 Feb 1970, Denmark. 6p.

A fuel assembly is described in which the fuel rods are arranged in a hexagonal or square, regular pattern, but in which single rods are omitted systematically and deflectors substituted. Each deflector is normally situated in a duct, the partition of which consists of six or eight fuel rods, respectively. The deflectors are rigidly connected to grids between the fuel rods so that the rods may expand freely in the grids. (Official Gazette)

25964 IN-CORE FLUX MONITORING SYSTEM FOR A BOILING WATER REACTOR. Bartlett, A. C.; Nelson-Jones, L. Technical Meeting No. 10/13. Basel; Nuclex (1972). 17p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

A complete incore flux instrumentation system for a boiling water reactor is described. This system comprises a pulse channel and Campbell channel, both of which are withdrawn from the core after operation, and ninety-six fixed power range detectors together with a moving detector for flux scanning and calibration. The system is capable of covering nearly eleven decades of neutron flux from 5×10^3 nv to 8×10^{13} nv. (auth)

25965 APPLICATION OF PROCESS COMPUTERS IN THE REACTOR PROTECTION SYSTEM OF NUCLEAR POWER PLANTS WITH BOILING WATER REACTORS. Boehm, E. Technical Meeting No. 10/9. Basel; Nuclex (1972). 13p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The reactor safety system of AEG boiling water reactors will be equipped with three process computers as evaluation units. The computers check all analog and digital signals every 30 ms. The hardware system and the operation manner are described. Some properties of the computer system are mentioned and compared with a hardwired system. (auth)

25966 STEAM TURBINES ASSOCIATED WITH ORDINARY WATER REACTORS OF 1200 TO 1300 MW. Brun, J.; Tessier, J. Technical Meeting No. 6/4. Basel; Nuclex (1972). 17p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

25967 CONSTRUCTION OF LARGE SATURATED STEAM TURBINES. Muehlhaeuser, H. Technical Meeting No. 6/1. Basel; Nuclex (1972). 39p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The current state of turbines for light water reactors is discussed with reference to the special features which these large machines possess. The recurring problems of erosion, corrosion, choice of material and correct speed are dealt with in detail. (auth)

25968 GENERAL ELECTRIC STEAM TURBINE-GENERATORS FOR NUCLEAR POWER PLANTS: A REVIEW AND OUTLOOK. Hegetschweiler, H. Technical Meeting No. 6/3. Basel; Nuclex (1972). 13p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Operating experience with General Electric-built large steam turbine-generators in utility-type nuclear power plants is reviewed. The efficiency performance and in-service reliability of these units are briefly discussed. Comments on the requirements of future units are added. (auth)

25969 PRACTICAL EXPERIENCE OF PLUTONIUM RECYCLE IN LWR'S. Bairiot, H.; Deramaix, P.; de Waegh, F.; Motte, F. Technical Meeting No. 5/7. Basel; Nuclex (1972). 30p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The Belgian program on Pu recycle covers both the PWR's and the BWR's. The main results obtained on fuels for BR 3, SENA, DODE-WAARD, GARIGLIANO, etc... are summarized with reference to more detailed technical literature. Adequate know-how and fabrication capacity is available for the Belgian industry to contribute to the commercial Pu recycle in power reactors. 11 references. (auth)

25970 FUEL TESTING AND POST IRRADIATION EXAMINATION. Mummery, P. W. (United Kingdom Atomic Energy Authority, Dounreay, Scotland); Barclay, F. J.; Nairn, J. S. Technical Meeting No. 5/9. Basel; Nuclex (1972). 11p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The UKAEA carries out irradiation testing of fuels for gas-cooled, water-cooled and fast reactors in the Windscale Advanced Gas Cooled Reactor, the Winfrith Steam Generating Heavy Water Reactor and the Dounreay Fast Reactor respectively, together with the Materials Testing Reactors DIDO and PLUTO at Harwell. The irradiation conditions are reviewed and reference is made to the extensive equipment available for post-irradiation examination of these fuels. (auth)

25971 FUEL CYCLES, FUEL FAILURES, AND THE MINI-OUTAGE. Jones, C. R. Technical Meeting No. 5/13. Basel; Nuclex (1972). 16p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

For light water reactors, very fast refueling can reduce the effect of failed fuel on operator exposure and release of fission products to the environment by quickly detecting and removing failed fuel. Equipment and procedures are being developed that make possible a refueling outage in about five days for an 1100 MW(e) BWR. (auth)

25972 EXPERIENCE WITH BWR FUEL. Williamson, H. E.; Ditmore, D. C. Technical Meeting No. 5/5. Basel; Nuclex (1972). 10p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

A review of experience with BWR Zircaloy-clad UO$_2$ pellet fuel is presented. Experience on the design, manufacture, quality control, and operation of a large volume of Zircaloy-clad UO$_2$ pellet fuel over the past 10 to 12 years has provided favorable feedback on the adequacy of the design for a commercial power reactor environment. Design and manufacturing improvements to minimize the incidence and effect of material variabilities, flaws, and impurities which occur statistically in large volume production processes are discussed. 6 references. (auth)

25973 ASEA–ATOM BWR: FUEL DESIGN, FABRICATION, AND PERFORMANCE. Hznnera, K.; Hetzler, F.; Hyden, L. Technical Meeting No. 5/6. Basel; Nuclex (1972). 9p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Some features of ASEA-ATOM's BWR fuel design and fabrication processes are given. The in pile fuel performance experience to date is reviewed. (auth)

25974 INFLUENCE OF DESIGN AND OPERATION PARAMETERS ON THE APPEARANCE OF DEFECTS IN FUEL RODS FOR BOILING WATER REACTORS. Grziwa, P.; Kuehn, H. Technical Meeting No. 5/8. Basel; Nuclex (1972). 12p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Typical defects on fuel rods for BWR's are discussed and specified in different failure-groups according to their main properties. The influence of some layout- and operation figures on the development of these defects is investigated. Some recommendations for a possible decrease in the failure-rate are made. (auth)

25975 CNEN's INTEGRATED DESIGN AND FABRICATION CAPABILITY FOR LWR PLUTONIUM FUEL. Schileo, G. (CNEN, Rome). Technical Meeting No. 5/19. Basel; Nuclex (1972). 16p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Within the activities sponsored by CNEN's Plutonium Program novel and original solutions for nuclear fuels have been conceived, developed and extensively tested both out-of and in-reactor. CNEN has manufactured and guaranteed full-scale plutonium fuel elements to a German utility and it is receiving the payment based on the thermal energy produced. One such element has been under service for over one year and a half. This effort resulted in an integrated design and fabrication capability for LWR plutonium, and uranium-fuel as well. (auth)

25976 CONSIDERATIONS EMERGING FROM FUEL MANAGEMENT EXPERIENCE WITH ENEL'S REACTORS. Belelli, U.; Cometto, M. Technical Meeting No. 5. Basel; Nuclex (1972). 13p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The fuel behavior in ENEL's nuclear power stations, Garigliano, Trino Vercellese and Latina is reviewed. The operation of these stations has allowed ENEL to acquire a noticeable experience on the various aspects of the fuel cycle, thus determining the evolution of the basic criteria of fuel management. A few meaningful examples of this evolution and the economic and contractual implications resulting from the assumption by the utility of wider responsibilities in core management are discussed. In connection with the destination of the fissile materials recovered from reprocessing, an illustration of the technical basis and the economic considerations which led ENEL to start recycling plutonium in its reactors in 1974 is presented. (auth)

25977 PREPARATION FOR EXPLOITATION OF PRESTRESSED CONCRETE REACTOR VESSELS FOR LIGHT WATER REACTORS. Margen, P. H.; Menon, S. (Aktiebolaget Atomenergi, Studsvik, Sweden). Technical Meeting No. 2/6. Basel; Nuclex (1972). 17p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Progress made on the Scandinavian program of developing PCRVs for LWRs is described. The program is focused on a BWR design which allows the introduction of PCRVs while using standard components and layout from steel vessel BWRs to a very large extent. The progress made on design led to some improvements in matters of detail, and this together with the extensive continued experimental program (which included overpressure tests at three times working pressure and severe accident simulations on the Studsvik model vessel) are considered to have led to a mature design and to have established its feasibility in all aspects. The detailed design and the design studies have also shown the strong merits the design has in respect of very high safety and ease of extrapolation to large sizes, and that cost savings should acrue already at the 900 MW(e) size studied in detail. A design of a 2000 MW unit is briefly shown to illustrate the adaptation to larger future options. The program of complimentary work which has been proposed for giving the residual information desired to complete the basis for a decision on the commitment of a large nuclear plant is also described. While the Scandinavian PCRV program has been focused primarily on BWRs, the design options also for PWRs with PCRVs show that incentives exist also in their case, though they may not be quite as strong as in the case of BWRs and require more verification work. It is shown that the Scandinavian PCRV program provides valuable information also for the adaption of PCRVs to PWRs. (auth)

25978 WASTE GAS SYSTEM FOR BOILING WATER REACTORS, OPERATING EXPERIENCE IN MUEHLEBERG AND RESULTING IMPROVEMENTS. Hentschel, G.; Stejskal, J. Technical Meeting No. 2/7. Basel; Nuclex (1972). 10p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

A discussion of the reasons which led to the selection of adsorption on charcoal at ambient temperature for purification of radioactive contaminated off-gas streams is followed by a brief description of the Muehleberg off-gas system. The most important operating experiences are described and the resulting simplifications and operational improvements are presented. (auth)

25979 PERIODIC INSPECTION OF STEEL REACTOR VESSELS. Nichols, R. W.; Watkins, B.; Jackson, H. (United Kingdom Atomic Energy Authority, Risely, Eng.). Technical Meeting No. 9/13. Basel; Nuclex (1972). 12p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Some of the requirements are presented for the periodic inspection of light water reactor steel pressure vessels with reference to ASME XI. Manipulator devices and closed-circuit television techniques are described. A B-scan presentation device which gives a cross-section picture of the weld being examined ultrasonically is also described. (4 references) (auth)

25980 ENVIRONMENTAL RADIOACTIVITY SURVEILLANCE AROUND NUCLEAR POWER FACILITIES. Logsdon, J. E.; Culliton, M. A. Technical Meeting No. 9/11. Basel; Nuclex (1972). 14p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The U.S. Environmental Protection Agency guidance for conducting environmental radioactivity surveillance programs around light-water-cooled nuclear power facilities is presented. (5 references) (auth)

25981 PRESENT PRACTICES AND FUTURE TRENDS IN AIR FILTRATION IN NUCLEAR POWER STATIONS. Marble, R. I. Technical Meeting No. 9/9. Basel; Nuclex (1972). 10p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

There are air filtration systems available to provide cleaned air for normal ventilation and to collect radioactive materials in the effluent air, both in normal operation and under emergency conditions. Conditions vary with the type of Plant (BWR, PWR, and HTGR), but the filters used are the same. Future requirements may involve different configurations or combinations, but no basically different filters are contemplated. (10 references) (auth)

25982 CONFIRMING THE PERFORMANCE OF BWR EMERGENCY CORE COOLING SYSTEMS. Ianni, P. W.; Murray, J. L.; Stuart, I. F. Technical Meeting No. 9/7. Basel; Nuclex (1972). 14p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

In early 1972 General Electric introduced the sixth generation of the boiling water reactor (BWR). Following Dresden 1 in the 1950's changes in the BWR have been made at discrete intervals in an orderly manner. The latest generation–The BWR/6–in addition to producing about 20 percent more power for a given vessel size, results in significantly reduced peak cladding temperatures under loss-of-coolant accident (LOCA) conditions. The emergency core cooling system (ECCS) performance for the BWR/6 as well as some of the key confirmatory tests which have been conducted on the ECCS performance are discussed. (6 references) (auth)

25983 UNDERGROUND NUCLEAR POWER STATIONS. Wanner, A.; Winkler, W. Technical Meeting No. 9/5. Basel; Nuclex (1972). 12p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The possible reasons leading to the construction of an underground nuclear power station are studied. The associated cost increase and longer construction schedule are estimated for types of 1000 MW(e) LWR and for Swiss conditions. (auth)

25984 RISK OF AN AIRCRAFT CRASH ON A NUCLEAR POWER PLANT. Joerissen, G.; Zuend, H. Technical Meeting No. 9/4. Basel; Nuclex (1972). 12p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The probability and the consequences of an aircraft crash on a nuclear power plant incorporating a light water reactor are estimated considering the probabilities of an aircraft strike, missile penetration through walls and damage of structures and systems important for safety. The estimated risks are presented in a Farmer diagram and compared with tolerable risk limits. (6 references) (auth)

25985 SAFETY AND ENVIRONMENTAL PROTECTION IN NUCLEAR POWER PLANTS WITH BOILING WATER REACTORS. Voigt, O. Technical Meeting No. 9/2. Basel; Nuclex (1972). 21p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The characteristics of inherent safety of the AEG-Boiling Water Reactor are complemented by means of a multitude of protective systems. These are harmonized in a way which yields equal protection with respect to all situations under consideration. Operating experiences, large scale experiments and systems analysis provide the basis for further improvements. (auth)

25986 SPECIAL CONSTRUCTION AND FABRICATION PROBLEMS IN INSTALLATIONS FOR WATER-COOLED REACTORS. de Comtes, H.; Furthner, A.; Mayrhofer, M.; Wallner, F. Technical Meeting No. 2/10. Basel; Nuclex (1972). 13p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Some questions referring to manufacture of core structures for water-cooled nuclear reactors are discussed, especially requirements for materials and accurate sizing during welding and machining. (auth)

25987 INTRODUCTION OF FERRITIC CHROME STEEL WITH SPECIAL CONSIDERATION OF THE NEW ELA FERRITE IN REACTOR CONSTRUCTION (BOILING WATER REACTORS). Frinken, H. (Edelstahlwerk AG, Witten, Ger.). Technical Meeting No. 2/9. Basel; Nuclex (1972). 12p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Stainless Chromium Steels such as AISI 410 are multi-phased. The mechanical and chemical-corrosive characteristics depending on this make production and fabrication rather difficult. Modern production techniques have made the development of new mono-phased Chrome-Molybdenum-Steels possible. These ELA-Ferrites are superior to all known steels. Therefore they are well adapted for use in nuclear-reactor construction. (auth)

25988 ASEA-ATOM BWR. DEVELOPMENT AND CORE PERFORMANCE EXPERIENCE. Bernander, O.; Haga, I.; Segerberg, F. Technical Meeting No. 2/3. Basel; Nuclex (1972). 18p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Although the present status of the boiling water reactor is one of proven technology, design refinements and technical innovations are still being made to further improve reliability, economy and safety. The new standard ASEA–ATOM BWR features a number of such refinements and design improvements involving main circulation pumps, containment design, refuelling system and off-gas treatment plant. In some respects the nuclear and hydraulic design of the ASEA–ATOM BWR differs from that adopted by other BWR manufacturers. Since the Oskarshamn I plant was the first nuclear power station having these features an extensive physics and hydraulics test program was made during the reactor start-up. The results of these tests have fully confirmed the ability of calculation methods to predict the behavior of the reactor. (auth)

25989 AEG BOILING WATER REACTOR: DESIGN, EXPERIENCES, AND FUTURE DEVELOPMENT. Engel, H.; Koch, M.; Kuehnel, R. Technical Meeting No. 2/2. Basel; Nuclex (1972). 16p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The outstanding features of the AEG boiling-water reactor are coolant recirculation inside the reactor pressure vessel, a compact pressure suppression system, and excellent emergency core-cooling properties. Well-proven activity treatment systems enable locations to be chosen in the vicinity of high population density. The experiences gathered so far are for the most part favorable, although certain difficulties have occurred during condensation processes in relief operation (in the case of Wuergassen). Sufficient operational experience has not yet been gained with cyclically stressed fuel elements of high power density. The primary objectives for further development are product assurance, improvement of operational behavior and safety. The new AEG-product line at present being planned will show more favorable construction from the safety aspect and a optimization of its design. (auth)

25990 FIVE YEARS OF OPERATION OF THE GUNDREMMINGEN NUCLEAR POWER PLANT. Bridenbaugh, D. G.; Turner, R. L.; Ettemeyer, R. Technical Meeting No. 2/1. Basel; Nuclex (1972). 20p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

At the beginning of the refueling outage in May, 1972, the 250 MW Gundremmingen Nuclear Power Plant (KRB) completed five years of commercial service. The plant has operated at essentially a 100 percent capacity factor between each refueling outage since the completion of the first refueling outage in August, 1969. In the five continuous years of operation there have been no forced outages caused by the nuclear steam supply system (NSSS). Information gained during this five-year period on plant performance, fuel performance, equipment maintenance, and the effect of plant effluents on plant environs is presented. (auth)

25991 DESIGN FEATURES OF A NEW CLASS OF BWRs. Bray, A. P.; Rubio, A.; Imhoff, D. H. Technical Meeting No. 2/4. Basel; Nuclex (1972). 16p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The new design features of the BWR/6 reactors are described. These new features include steam separators, jet pumps, a new lattice, increased power density but lower fuel duty, and various safety features. (JWR)

25992 IMPROVEMENTS IN NUCLEAR PLANT EFFLUENT CONTROL SYSTEMS. Kjemtrup, J. E.; Smith, J. M. Technical Meeting No. 9/17. Basel; Nuclex (1972). 4p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Over a decade of operating experience is now available for commercial boiling water reactor (BWR) nuclear power plants. Experience with existing plants of release of radioactive materials to the environment has indicated a high degree of compliance with a conservative design objective. In consequence, offplant radiation doses have been very small compared to permissible or natural background. Advanced effluent management systems are being offered now for use with the modern BWR. These systems provide the BWR with capability to meet the proposed regulations of the United States Atomic Energy Commission (USAEC) in Appendix 1 of 10 CFR 50. The systems are designed with the objective of eliminating radioactive releases to the fullest extent practicable. The key systems described are: a maximum recycle radioactive liquid treatment system utilizing traveling belt filters for solids concentration which treat all liquid waste streams which are major carriers of radioactivity to purify the water for recycle to inplant usage; and a high performance offgas effluent control system. (auth)

25993 NEW METHOD OF ASSESSING THE ENVIRONMENTAL INFLUENCE OF COOLING TOWERS AS FIRST APPLIED TO THE KAISERAUGST AND LEIBSTADT NUCLEAR POWER PLANTS. Boegh, P.; Hopkirk, R.; Junod, A.; Zuend, H. Technical Meeting No. 9/25. Basel; Nuclex (1972). 25p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The extensive environmental studies performed in Switzerland for the cooling towers of the Kaiseraugst and Leibstadt Nuclear Power Plants are presented. The computer program SAUNA for the calculation of the cooling tower plume behavior is briefly described. The main results of the environmental studies are summarized. (8 references) (auth)

25994 PREPARING THE NUCLEAR POWER PLANT GOESGEN–DAENIKEN. Utzinger, E. (Kernfraftwerk Goesgen–Daeniken AG, Daeniken, Switzerland). Atomwirt., Atomtech.; 14: No. 1, 31-32(Jan 1974). (In German).

The nuclear power plant Goesgen–Daeniken is one of the three out of eight Swiss reactor projects, for which a main supplier has already been determined. At the end of February 1973, the Kernkraftwerk Goesgen–Daeniken AG has signed a letter of intent, entrusting the German Kraftwerk Union AG (KWU) to deliver a turn-key nuclear power plant with the Siemens pressurized water reactor. The power of the reactor should be 963 MW(e) gross, respectively 920 MW(e) net. After having rejected several objections raised against the construction of this power plant, the Government of the canton Solothurn gave the permission to start preparatory construction works including the lowering of underground water, and for taking and returning of cooling water with wet cooling towers. (GE)

25995 970 MW NUCLEAR POWER PLANT GOESGEN–DAENIKEN. Description of Technical Details of the Plant. Plewa, H. (Kraftwerk Union AG, Erlangen, Ger.). Atomwirt., Atomtech.; 14: No. 1, 33-36(Jan 1974). (In German).

The Swiss nuclear power plant Goesgen–Daeniken with its concept of a pressurized water reactor of the German Kraftwerk Union AG corresponds to the German nuclear power plant Neckarwestheim currently under construction, this one being in its technical design a logical further development of the German nuclear power plants Obrigheim and Stade. As an improvement with respect to these stations, in the Goesgen–Daeniken reactor the two safety containments, placed into one another, are arranged eccentrically to one another for the first time. Thus, the fuel handling system and a great part of the auxiliary equipment can be placed between the steel containment and the ferro-concrete vessel, the latter one being safe against airplane crash. The cooling water supply (wet cooling tower), auxiliary and administrative buildings are erected by the builder. The starting point is planned to be end of 1977. (GE)

25996 EXPERIMENTAL RESEARCH ON THE PROCESS OF FORCED CONVECTION OF WATER IN MOCK-UPS OF NUCLEAR POWER REACTORS. Haiduc, C.; Vinitchi, V.; Vidican, P.; Isbasescu, E.; Bercovici, D.; Adamesteanu, J. Stud. Cercet. Energ. Electroteh.; 23: No. 3, 591-598(1973). (In Rumanian).

The experimental results obtained in studies on heat transfer in reactor mock-ups are reported. The experimental thermal loop for the simulation of forced convection processes is described. (tr-auth)

25997 PROBABLE COSTS OF REACTOR SAFETY. Rippon, S. New Sci.; 61: No. 883, 252-255(31 Jan 1974).

Environmentalists and engineers in the United States are involved in a bitter argument over the safety of light water reactors. It is emphasized that when talking about the safety of nuclear power plants levels of safety many orders of magnitude better than any other human activity and no less than 10,000 times safer than typical "acts of God" are being considered. The belief that a major nuclear accident would be more widespread and devastating than anything known before leads one to consider a very high criterion for safety measures. Three basic levels of safety philosophy adopted by the US for the design and regulation of all nuclear installations are considered with special consideration of the light water reactor design. Containment of the system and the concept of "maximum credible accident" are discussed. The problem of hypothetical accidents is examined. (UK)

25998 INFLUENCE OF OXYGEN IN NEUTRAL OPERATION. Borris, B. (Gemeinschaftskraftwerk Weser GmbH, Valtheim, Ger.). (1973). vp. (In German).

From VGB conference on chemistry in power plants; Essen, Germany (23 Oct 1973).

The conditioning with oxygen to form and conserve stable protective layers, the findings that oxygen has a protecting effect also on copper and brass, and the reaction processes during formation of the surface layer in the water and vapor phase are described. The operating results correspond to the experience gained with coolant circuits of boiling water reactors operated with neutral water free from salts and containing oxygen. The behavior of materials containing Cu is more complicated than those containing Fe. Experiments of conditioning in conventional blocks of power plants with low-pressure preheaters made of brass have led to a considerable decrease of metal emission rates. (GE)

25999 EVOLUTION OF THERMODYNAMIC CYCLES IN NUCLEAR POWER PLANTS. General Principles and Review of Some Thermodynamic Cycles Used in Nuclear Power Plants. Chambadal, P. (Societe Francaise des Thermiciens, Paris). Rev. Gen. Therm.; 12: No. 141, 767-774(Sep 1973). (In French).

The thermal and energy efficiencies of a conventional thermal power plant and a nuclear plant are defined. The study of the coefficient of energy utilization (the ratio of these efficiencies) demonstrates the importance of correctly effecting the heat exchange between the fluid flowing through the reactor of a nuclear power plant and the fluid expanding in the turbine. The operation of the heat exchangers is studied for the case of both water cooled and carbon dioxide cooled reactors. The various means suggested for improving the thermodynamic cycle are illustrated for the case of currently operating French nuclear power plants. (FR)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 25949–25951, 25953, 25954, 25956, 25957, 25959, 25961, 25966, 25967, 25969, 25971, 25975, 25976, 25979–25981, 25983, 25984, 25986, 25996, 25997, 25999, 26089, 26177, 26179, 26194, 26278, 26285, 26291, 26292, 26312, 26316–26318, 26321, 26323–26325, 26329, 26331–26334, 26337, 26338, 26341–26349, 26354, and 26356–26359.

26000 (CONF-730942-P3, pp vp Paper G 4/8) EXPERIMENTAL AND THEORETICAL ANALYSIS IN ELASTIC-PLASTIC FRACTURE MECHANICS. Stumpp, W.; Varga, T.; Boyle, E. F. (Gebrueder Sulzer Aktiongellschaft, Winterthur, Switzerland). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The brittle fracture safety of the housing of a main coolant pump in a reactor primary circuit (PWR) will be examined. The housing is almost spherical and constructed from three cast steel components welded together. The inner surface is clad with austenitic stainless steel. The main dimensions are (1) maximum diameter 2750 mm, (2) wall thickness up to 550 mm, (3) weight 32 metric tons. Although a stress relief heat treatment was applied, residual stress up to 10 kp/mm^2 has been taken into consideration. Except for the exit nozzle, the housing can be regarded as rotationally symmetric and this assumption was made to simplify the stress analysis. The finite element method was used to examine the three most severe loading conditions in the working cycle (1) start up, (2) running, (3) shut down, together with the proof test loading. Also, the static and transient temperature fields have been determined by analytical procedures. The results of these analyses were used to specify regions of maximum stress level. A brittle fracture safety evaluation is particularly important in this case because a ferritic steel of the type GS 20 Mo 4 (CO·20, Mo 0·4), instead of the more usual austenitic, was used for the casting. Also, experience shows that cast material is more susceptible to defects than the same plate material. A previously published "systems approach" used to provide a logical procedure for brittle fracture assessment indicates that impact testing should be considered first. However, quantitative data were necessary in this case, so that neither impact testing nor the "next step", drop weight testing were completely adequate although they provided useful quality control information. Consequently, 4 inch compact tension specimens were tested in the probable "proof test" temperature range. Fractures did not occur within the specified limits for a linear elastic treatment and some critical defect sizes were defined on the basis of the non-valid K_Q concept. Crack opening displacements (COD) were also measured employing a newly developed technique on a modified CT specimen geometry. The critical defect sizes derived from the COD at fracture were found to be considerably larger than those calculated from K_Q. The COD, together with Rice's contour integral J, were also determined from elastic plastic finite element calculations. Thus, experimentally and theoretically measured values are compared and discussed for the first time. (auth)

26001 (CONF-730942-P3, pp vp Paper H 1/6) STRESS CONCENTRATIONS AROUND A LARGE CIRCULAR OPENING CONSIDERING THE TENSILE FAILURE OF CONCRETE. Takemori, T.; Kuwabara, Y. (Taisei Corp., Osaka). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Stress concentrations around a circular opening located in a flat plate whose material is elastic, linear, and homogeneous have been alalyzed theoretically in many studies. This theory will, however, not be reasonable to be applied directly to materials such as concrete, which have much smaller tensile strength compared with its compressive one and, moreover, is subject to tensile stress under reinforcement by bars. When concrete is subject to tensile stress, cracks occur in low tensile stress condition level and tensile failure follows. But in case of reinforced concrete, tensile stress after tensile cracks occurred is mainly imposed to reinforcing bars. That is, when the tensile strain of reinforced concrete member reaches about 1.0×10^{-4}, tensile cracks begin to appear in concrete. As load increases, the number of cracks increases and strain is radically enlarged approaching the strain of reinforcing bars only. This phenomenon is verified by uniaxial tensile tests. This phenomenon is taken into consideration for the plane problem, and stress concentrations and displacements by seismic forces around a large circular opening located on reactor containment facility for the PWR type nuclear power plant, are studied together with elastic cases. The outer shield wall is a reinforced concrete cylindrical shell structure, whose thickness and outside diameter are 90 cm and 44.3 m respectively, and the diameter of the opening is 6 m. Since the diameter of the outer shield wall is large enough compared with the diameter of the opening, the analytical model used is treated as a flat plate with an opening. According to the result of this investigation, when large tensile stresses are yielded in concrete around openings under tensile or shear force due to seismic loads, it is fully understood how tensile stresses in concrete are transfered to reinforcing bars after tensile cracks occurred, and how different displacements are from elastic cases. A finite element computer program is used which has been developed for evaluation of elastic-plastic problems. A finite element is composed of a concrete element representing idealized "bilinear" elasticity and a reinforcing steel element representing "linear" elasticity. These elements are laminated on same plane and each node is connected to each other so that equilibrium of displacements are satisfied. The modulus of elasticity of concrete in reinforced concrete after tensile cracks occurred, has slightly minus value as verified in experimental results. However, the value is taken as zero in this study for conveniences' sake of computer program. It is recommended that the analysis mentioned be applied to design of reinforced concrete structures of nuclear power plant, in which tensile stresses are severe and displacements important. (auth)

26002 (IFA-FR-116-1973) ELECTROCHEMICAL AND RADIOLYTIC INVESTIGATION OF WATER AND THE ROLE OF pH DETERMINATION IN WATER–WATER REACTORS WITH LARGE NEUTRON FLUX. Aleksan, Z.; Ionesku, E.; Vidrigin, R.; Mots, L. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 38p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.00.

The electrochemical and radiolytic properties of water are reviewed. Experimental data on the measurement of the pH in the coolant water of WWR-S type reactors and the effect on Al corrosion are reported. The radioisotopes induced in the primary circuit of power reactors are tabulated. The change of pH in power reactors is illustrated with data from Saxton and Yankee reactors. The mechanism of the pH effect is given. (JSR)

26003 MULTI-BARRIER CONTAINMENT SPEEDS CONSTRUCTION. Energy Int.; 11: No. 2, 19(Feb 1974).

The multi-barrier containment system at the Davis–Besse nuclear power plant near Toledo, Ohio features a free-standing, pressure vessel surrounded by a concrete biological shield building. Multi-barrier containment vessels have an annular space between the pressure vessel and the shield building that may be utilized to confine, collect, and filter out fission products in the event the primary containment structure is violated. This design features the fission product clean-up system in an adjacent auxiliary building. (MCW)

26004 METHODS FOR THE DETERMINATION OF NEUTRON FLUX. The Aeroball in de Ardennes Nuclear Plant (Chooz). Poncelet, J. P. Louvain, Belgium; Univ. Louvain (1973). 55p. (In French).

Thesis.

The systems of neutron flux measurement available and their principal advantages and disadvantages are described. The fashion in which the aeroball techniques permit an efficient measurement is studied. The sources of error and their order of magnitude are evaluated. (tr-auth)

26005 PWR PROTECTION SYSTEMS, SAFETY, RELIABILITY, AND AVAILABILITY. Hall, A. Technical Meeting No. 10/3. Basel; Nuclex (1972). 23p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Westinghouse's experience with its control and protection systems is described. Their effects on the safety, reliability and availability of the plant are reviewed. Both operational experience and analytical supporting work are discussed. Examples are given of system modifications which have been implemented as a result of operational experience. Space limitations prohibit a full description of the control and protection systems, but a brief anatomical description is given together with a tabular listing of the principal sub-systems. (auth)

26006 HELICAL BOILERS FOR NUCLEAR SYSTEMS. Worley, N. G. Technical Meeting No. 6/6. Basel; Nuclex (1972). 16p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Helical boilers are being employed or are proposed for gas-cooled reactors, both the Advanced Gas-Cooled Reactor (AGR) and High-temperature Gas-cooled reactor (HTGR) types, sodium cooled fast reactors and water reactors for marine propulsion. The major technical characteristics of boilers of this type are described. The experimental and fabrication developments which form the technical background to nuclear helical boiler systems are also covered. (auth)

26007 EXPERIENCE ACQUIRED IN THE CONSTRUCTION OF HIGH POWER NUCLEAR TURBINES. Riollet, G. Technical Meeting No. 6/2. Basel; Nuclex (1972). 26p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

It is intended to study the main problems arising from the design of the first four 1000 MW nuclear turbines to be installed in France in association with light water reactors. With regard to their main features, the solutions which were chosen have already been confirmed by experience either through a satisfactory behavior in service on other turbines, or, as far as the manufacturing processes are concerned and especially for the low-pressure rotors, through the realization of the two 500 MW units for Tihange power station in Belgium. (auth)

26008 IRRADIATION PERFORMANCE OF ZRY-CLAD FUEL ELEMENTS OF THE OBRIGHEIM PWR PLANT. Knoedler, D.; Schenk, H.; Stehle, H. Technical Meeting No. 5/1. Basel; Nuclex (1972). 23p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The KWO plant is just ending its third operational cycle. Until now 214 fuel assemblies have been loaded. A maximum burnup of 36,000 MWd/tU has been achieved. Inspections performed with pool-site facilities and hot cells revealed valuable information about crud deposition, corrosion and hydrogen pick-up, length growth, defect behavior etc. Altogether the fuel performed highly satisfactorily. The occurrence of some defect fuel rods did not impair the availability of the plant. 12 references. (auth)

26009 SURVEY OF WESTINGHOUSE NUCLEAR FUEL PERFORMANCE. Bader, J. F.; Evenepoel, R. P.; Thiessen, C. W.; Dollard, W. J. Technical Meeting No. 5/2. Basel; Nuclex (1972). 12p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

A survey is presented of the performance over the past four years of zircaloy clad fuel elements from Westinghouse. (auth)

26010 EVALUATION OF THE TIGHTNESS OF FUEL ELEMENTS IN PRESSURIZED WATER REACTORS DURING OPERATION AND FUEL ELEMENT EXCHANGE. Samuel, T.; Kueffer, K.; Wenger, J. P. Technical Meeting No. 5/4. Basel; Nuclex (1972). 15p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Based on the operating experience gained at the Beznau Nuclear Power Plant, criteria are established and discussed which would allow the operator to evaluate the performance of the fuel in reference to fuel leakage during operation. Furthermore a method offering the possibility to approximately locate defective fuel elements during operation is given. Finally a review of the fuel element sipping methods used up to now during refueling is presented and a new method developed and tested at the Beznau Plant including the sipping results obtained is described. (auth)

26011 FACTORS INFLUENCING GROWTH OF PWR FUEL RODS. Chernock, W. P.; Stewart, J. R. Technical Meeting No. 5/3. Basel; Nuclex (1972). 15p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Factors responsible for axial growth of fuel rods are reviewed and discussed on the bases of ex-reactor autoclave growth studies. The influence of fuel-cladding mechanical interaction, differential thermal expansion between the fuel and the cladding and stress relaxation of Zircaloy are assessed and are included in the growth model. (auth)

26012 POST-IRRADIATION EXAMINATIONS OF TRINO VERCELLESE REACTOR FUEL. Bannella, R.; Casini, R. Technical Meeting No. 5/14. Basel; Nuclex (1972). 16p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The performance of the stainless steel clad fuel irradiated in the Trino Vercellese reactor during two cycles is presented along with the results of post-irradiation examinations performed on selected assemblies discharged at the end of Cycle 1 and of gamma scanning measurements taken at the end of Cycle 2. 7 references. (auth)

26013 NUCLEAR FUEL ASSEMBLY MEETS AEC CRITERIA. Nakazato, S. (Westinghouse Electric Corp., Pittsburgh). Elec. World; 181: No. 2, 64-67(15 Jan 1974).

Fuels for the Westinghouse pressurized water reactor have evolved to the 17 × 17 fuel-assembly design from the same geometric and power envelope of the current 15 × 15 fuel assembly design. Details of the component tests, with the purpose of each and the specific parameters measured, are tabulated. Mechanical tests performed on the assembly and various test data measured on each fuel assembly from a large-scale full-flow hydraulic loop are shown. Nuclear and thermal-hydraulic analyses are being conducted parallel to mechanical-design activities. (MCW)

26014 LOW-SPEED 1,160 MW SATURATED STEAM TURBINE FOR THE NUCLEAR POWER PLANT DONALD COOK. Arch. Energiewirt.; 27: No. 24, 1217-1223(Dec 1973). (In German).

The turbo set of the pwr-type reactor Donald Cook is described. (GE)

26015 REFERENCE PLANT DESIGN AN OPTIMIZED PWR PLANT LAYOUT. Erion, T. L.; Saint-Paul, R. Technical Meeting No. $^1/_3$. Basel; Nuclex (1972). 14p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Having gained valuable experience in the whole field of nuclear power generation, Westinghouse has undertaken the design of complete nuclear plants with particular attention given to the optimization and standardization of equipment, systems, structures and layout. The general layout of these optimized units is described, as are the benefits of this concept with regard to construction, operation, economy and maintenance. (auth)

26016 DESIGN IMPROVEMENTS AND OPERATING EXPERIENCE OF WESTINGHOUSE INTERNAL REACTOR STRUCTURE. Finn, J. Technical Meeting No. 1/12. Basel; Nuclex (1972). 18p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The evolution of Westinghouse's reactor internals designs from the early plants as SENA and SELNI to the present standard two, three and four loop plants is described. The problems encountered in the early designs and the mechanical improvements realized as the designs evolved towards higher power densities and greater flow rates are discussed. The analytical studies, the scale model, and in-plant testing work which led to the actual basic design are emphasized. (auth)

26017 SAFETY AND LICENSING ASPECTS OF PRESSURIZED WATER REACTORS IN THE USA. Stathoplos, A.; Goodwin, W. A. Technical Meeting No. 9/6. Basel; Nuclex (1972). 10p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

A number of safety-related issues are receiving particular attention by licensing agencies in the U.S. at the present time; these include the Loss-of-Coolant Accident, Common Mode Failures, and Anticipated Transients Without Scram. Combustion Engineering has performed analyses for its Nuclear Steam Supply Systems for each of these eventualities and has demonstrated the adequacy of the system in limiting the severity of the consequences. (4 references) (auth)

26018 HYBRID COMPUTER MODEL FOR THE LOSS-OF-COOLANT ACCIDENT IN PRESSURIZED WATER REACTORS. Maslo, R. M.; Nahavandi, A. N. Technical Meeting No. 9/15. Basel; Nuclex (1972). 23p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The current analytical techniques for the prediction of the plant dynamic behavior during a loss-of-coolant accident in pressurized water reactors are inadequate. More sophisticated approaches, needed for the plant safety evaluation, require prohibitively large amount of digital computer storage and running time. A hybrid (digital-analog) computer technique as a means for improving the computational efficiency for the solution of the loss-of-coolant accident problem. (6 references) (auth)

26019 EXPERIENCE GAINED AND PROGRESS MADE WITH SIEMENS-PWR TECHNOLOGY. Braun, W.; Sparhuber, R. Technical Meeting No. 1/4. Basel; Nuclex (1972). 13p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The design of SIEMENS-PWRs is based upon 3$^1/_2$ years operating the 330 MW(e) Obrigheim and upon the timely commissioning of the 630 MW(e) Stade nuclear power plant. For high reliability of reactor plant and fuel, proven components and design principles are retained wherever possible. By comprehensive safety R&D, licensability will be maintained regardless of site conditions. Unrestricted accessibility and spaciousness of the containment provide for good maintainability of SIEMENS-PWRs. Due to the fact that all nuclear power plants so far built by Kraftwerk Union AG. are turnkey-contracts, SIEMENS-PWRs represent an integral part of the plant and include a maximum of construction and operating experience. (auth)

26020 HIGHER WATT DENSITY ELECTRIC HEATING ELEMENTS FOR WATER REACTOR PRESSURIZERS. Noel, B. Technical Meeting No. 1/17. Basel; Nuclex (1972). 9p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The Watlow direct immersion type heater offers something not previously available in pressurizer heaters—high watt density with improved reliability. This means decreased heater cost and considerably fewer penetrations required in the pressurizer. In fact, the high watt density direct immersion unit actually operates at internal temperatures of 500 to 700°F less than the presently used indirect low watt density pressurizer heaters. Both type heaters are presently being tailored to meet Section III and/or VIII of ASME Boiler Code plus all special customer specifications. (auth)

26021 PERFORMANCE OF THE ARDENNES NUCLEAR POWER PLANT. Bertron, L. Technical Meeting No. 1/2. Basel; Nuclex (1972). 12p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The performance of the Ardennes Reactor during power operation since the plant shutdown due to reactor failure and the future of the power station are discussed. (auth)

26022 MULTI-BARRIER CONTAINMENT VESSELS. Dunn, T. T. Technical Meeting No. 1/11. Basel; Nuclex (1972). 15p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

With the successful completion of a number of multi-barrier containment vessels it is clear that another containment vessel design is available to nuclear power plant designers. The obvious advantages of simplified shield building construction and separation of building trade crafts, coupled with an ASME Code designed steel vessel for the pressure barrier, provide flexability for construction and licensing problems. In addition, these contracts were awarded on a lump sum basis and the work was performed on a fixed schedule. The practicability of multi-barrier containment along with the additional safety features make this concept attractive for future power plant designs of all types. (auth)

26023 SELECTION AND USE OF MATERIALS FOR THE COMPONENTS OF NUCLEAR REACTORS. Dobourg, M.; Martin, J. Technical Meeting No. 1/5. Basel; Nuclex (1972). 7p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

For the manufacturing of the TIHANGE and FESSENHEIM reactor internals, CREUSOT-LOIRE and FRAMATOME have selected an austenitic stainless steel grade that is suitable for both mechanical properties and the resistance to intergranular corrosion tests conducted according to the standard practice. (auth)

26024 SPECIAL ENGINEERING EXPERIENCES DURING OPERATION OF THE BEZNAU NUCLEAR POWER PLANT. Baschek, H.; Iten, W.; Jacobi, A.; Kueffer, K.; Pescia, C. Technical Meeting No. 1/1. Basel; Nuclex (1972). 35p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Experiences which may be of considerable importance during the operation and maintenance of a nuclear power plant are discussed. Efforts which were undertaken to detect and reduce leakages are reported. Furthermore a method for sealing water-filled pipe sections by freezing is described. Underwater inspections and some particular experiences with auxiliary handling equipment are described. Problems during the inspection and repair work at the steam generators of Beznau I are discussed. (auth)

26025 CALCULATION, MATERIAL, AND MANUFACTURING PROBLEMS IN THE PREPARATION OF PRESSURE VESSELS FOR PRESSURIZED WATER REACTORS. Cech, F.; de Comtes, H.; Wallner, F. Technical Meeting No. 1/10. Basel; Nuclex (1972). 10p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Stresses in semi-hemispherical heads with non-radial nozzles, computation of temperature-field-patterns with the finite-element-method, materials, welding, cladding, and cleaning of PWR pressure vessels are discussed. (auth)

26026 PRIMARY COOLANT PUMPS FOR PRESSURIZED WATER REACTORS. Moritz, G. Technical Meeting No. 1/13. Basel; Nuclex (1972). 12p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The circulating pumps developed and constructed by Maschinenfabrik ANDRITZ AG for nuclear power stations with light and heavy water reactors are described, with a detailed account of the main coolant pumps for pressurized water reactors. A short description is presented of the development, construction, trial runs in the pilot plant and of the hydraulic design of these pumps. (auth)

26027 OCONEE MONITOR WARNS OPERATOR OF PARTS ADRIFT. Fairburn, G. T. (Babcock and Wilcox, Lynchburg, VA). Elec. World; 181: No. 1, 45-46(1 Jan 1974).

A loose-parts-monitoring system that was installed in the Oconee Units 1 and 2 is described. It detects noise from any foreign material in the primary system of the reactors. A block diagram of the monitoring system, its position in the reactor, and the location of the sensors that are attached to the upper end of each of the steam generators are shown. (MCW)

26028 HYDRODYNAMIC REGIME OF THE COOLING CIRCUIT OF A PWR-TYPE REACTOR. Danila, N.; Licsandru-Isbasescu, E.; Adamesteanu, J. Stud. Cercet. Energ. Electroteh.; 23: No. 4, 901-909(1973). (In Rumanian).

A general relation is presented for the calculation of the total loss of pressure in the primary circuit of a nuclear power station of the PWR-type. The data are obtained with a computer and are presented in the form of a nomogram. (tr-auth)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 25970, 25976, 25981, 25999, 26006, 26177, 26181, 26280, 26288, 26290, 26293, and 26312.

26029 (CEA-CONF-2529) HTR FUEL ELEMENT IRRADIATIONS. Ballagny, A.; Loriers, H.; Ringot, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91, Gif-sur-Yvette (France). Dept. de Technologie). [nd]. 14p. (CONF-731004-4). Dep. NTIS (U.S. Sales Only) $3.00.

From international conference on nuclear fuel performance; London, UK (15 Oct 1973).

The French program of HTR fuel development was first linked with the tubular interacting fuel pin concept. The fuel was manufactured in France according to the Dragon Project's basic technology. An anisotropic fine-grained extruded graphite was selected for the fuel tubes. Several fuel element irradiations have been achieved in the test reactors Osiris and Pegase, and in the Dragon Reactor Experiment. No failure has been observed with the reference fuel up to 3.2×10^{21} n/cm^2 DIDO Ni equivalent (DNE) under nominal conditions. In addition the fuel element has proven to sustain successfully severe accident conditions. The program was reoriented in 1972 to the integral block concept and a new series of tests is now under way. (auth)

26030 (CEA-N-1654) THERMODYNAMIC CONSIDERATIONS FOR HELIUM TURBINE PROJECTS. Maillet, E. (CEA Centre d'Etudes Nucleaires de Saclay, 91, Gif-sur-Yvette (France). Div. d'Etude et de Developpement des Reacteurs). Sep 1973. 19p. (In French). Dep. NTIS (U.S. Sales Only) $3.00.

The efficiency of the machine components and heat exchangers and the appropriate pressure drops are defined from knowledge acquired from brief studies effected up until the present day. A comparison between the different cycles (one, two, or three compressions) and the different temperatures and variable pressure ratios established the role played by the principal parameters. Subsequent studies refer to the effect of the compressed helium bypass necessary for cooling the rotors and stators of the machines as well as the accessory parts of the reactor. A review of the characteristic cycles appropriate to different temperature levels or power plant sizes shows that the gain in efficiency as a function of temperature is relatively small, but that a considerable reduction in flow rate and bulkiness is achieved as a result of both the high temperature and high pressure ratios. (FR)

26031 (CONF-730942-P3, pp vp Paper G 2/8) PRESTRESSED CAST-IRON PRESSURE VESSEL: ITS APPLICABILITY FOR GAS- AND WATERCOOLED NUCLEAR POWER REACTORS AND FOR IMPACT LOAD PROTECTION. Schilling, F. E.; Beine, B.; Gross, H. (Siempelkamp Giesserei KG, Krefeld, Ger.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The capability of cast iron of withstanding the combined action of radiation (well known in reactor technology) and of thermal and structural loads (well known from heavy machinery) has led to the construction of a prestressed cast iron reactor pressure vessel (PCIV). The PCIV is built of prefabricated transportable and machinable elements which are held together by the system of prestressing cables. A study of a cast iron pressure vessel was carried out in imitation of the essential design data of the PCPV of the THTR. Design criteria were developed and a cast iron model in the scale of 1: 7.5 to the THTR concrete pressure vessel was constructed. Hydraulic pressure tests have been made at 50 and 100 atm and 300 strain gauges have been used to measure the strains. From these strains the stresses were calculated. A pod-boiler PCIV model under construction for a 1160 MW(e) He-cooled reactor is also described. In the case a steel pressure vessel of a water-cooled reactor might burst, a limitation of the length of the crack and protection of the surroundings must be provided for. An impact load protector constructed of cast iron is described. (auth)

26032 (CONF-730942-P3, pp vp Paper H 1/1) RECENT DEVELOPMENTS IN THE FINITE ELEMENT ANALYSIS OF PRESTRESSED CONCRETE REACTOR VESSELS. Argyris, J. H.; Faust, G.; Szimmat, J.; Warnke, P.; Willam, K. J. (Univ., Stuttgart). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Recent developments of the finite element method as applied to linear and non-linear problems in pressure vessel analysis are described. The SBB finite element program for the analysis of PCRV is briefly summarized (Forschungsvorhaben Spannbeton-Reaktordruckbehälter), with particular reference to advances in finite element modelling techniques. The capabilities of the program are illustrated with the example of a three-dimensional substructure analysis of standpipe penetrations and their interaction with the global behavior of the containment which is in our case the THTR 1:5 scale Model. Thereafter, results of a parameter study on a "reference vessel" are presented in which the influence of material properties is investigated in regard to response of the structure. The effects of material non-linearities are dealt within the context of time dependent and time independent phenomena. Five different algorithms are briefly described for numerical solution of the non-linear problems. Limitations and shortcomings of these different methods are illustrated with the analysis of crack-propagation in a axisymmetric PCRV. Another investigation deals with two different concepts to characterize non-linear deformation behavior within the frame of non-linear elasticity or elastoplasticity. The effects of the different formulations are shown on the example of a reinforced disc exhibiting cracking and non-linear deformation behavior under lateral loading. Then the validity of some assumptions for the analysis of creep are reviewed with reference to the concepts of viscoelasticity and viscoplasticity. This critical appraisal is followed by a discussion on the numerical restrictions of the ensuing time-marching algorithms which arise due to the form of creep law used. These effects are then illustrated on the example of an axisymmetric PCRV. In conclusion, the formulations for creep, cracking and non-linear deformation behavior are combined for the analysis of a standpipe penetration zone subjected to transient pressure and temperature cycles. The computation of mode shapes and frequencies is briefly reviewed for the eigensolution of large scale problems. In essence, two techniques are compared for the eigencomputation of out-of-core matrices. The direct method involves static condensation and a finite number of similarity transformations for "hyper-tridiagonalisation" of the dynamic matrix. The iterative scheme operates directly on the original dynamic system iterating on vector subspaces which embed the desired eigenvectors. In conclusion, these two techniques are applied to the eigensolution of a complex PCRV for comparison of their computational merits. (auth)

26033 (CONF-730942-P3, pp vp Paper H 1/3) SOME SPECIAL PROBLEMS REGARDING THE ANALYSIS OF PRESTRESSED

CONCRETE REACTOR PRESSURE VESSELS WITH DUE CONSIDERATION TOWARD THE NONSTATIONARY TEMPERATURE FIELDS AND THE NONLINEAR BEHAVIOR OF THE MATERIAL. Hansson, V.; Schnellenbach, G. (Ruhr-Univ., Bochum, Ger.). 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Some special problems of calculations of local stress conditions influenced by non-linear material behavior are presented and the influence on required reinforcement and on the overall behavior of the vessel are discussed. Calculations are preformed by the dynamic relaxation method, and the formulation of non-linear material behavior is described and characteristic results are given. Some examples deal with the behavior of tensile zones of the THTR-pressure vessel with overpressure in addition to service load conditions. Other examples are concerned with stresses at hot spots, that are produced by local insulation failure. When temperature is raised in a local area of the inner surface during operation transient local temperature fields build up in addition to the normal temperature crossfall. They cause local compressive stresses which are reduced by creep. Higher creep in the region due to the local temperatures will also produce a redistribution of stresses effected by other loads. The temperature in the hot spot changes with the internal gas temperature. If temperature is removed after nearly a steady state of stress is reached, the local thermal stresses build up with reversed sign almost without recovery of creep. Dependent on the overall stresses in the vessel wall and the dimensions and temperature of the hot spot more or less severe local tensile stress fields develop in the region of the hot spot. For some examples for different shapes of regions the effects have been calculated in view of the local stresses and the overall behavior of the vessel. The influence of local cracking and conclusions for the required reinforcement are discussed. With some other examples the influence of tensile stress zones and local cracking on the overall behavior of the pressure vessel and on local stresses is of interest. The existence of tensile zones depends on the geometry of the vessel, on the prestressing, and on the loading conditions. As an example, the THTR-pressure vessel is taken under overpressure conditions. Local tensile stress zones develop here especially when an overload in addition to service load conditions is considered. Calculations with and without assumed cracked zones are performed. The calculation method for the cracked zones, results, the influence on the overall behavior of the vessel, and the required reinforcement are discussed. (auth)

26034 (CONF-730942-P3, pp vp Paper H 1/7) STRESS DISTRIBUTION IN THE LIGAMENT ZONE OF PERFORATED CIRCULAR DISCS WITH SPECIAL REFERENCE TO THE STANDPIPE REGION OF THE PCPV FOR GAS-COOLED REACTORS. Stefanou, G. D. (National Technical Univ., Athens). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The distribution of long-term stresses within the ligaments of perforated circular concrete slabs, subjected to long-term radial loading and uniform elevated temperature is discussed. The perforations are reinforced with steel liners and arranged in a square central lattice symmetrical about two orthogonal axes. In order to assess the stress distribution around the perforated zone of a circular slab, a method of analysis was developed, based on the "Equivalent Elastic Modulus" of the perforated zone, and the "Effective Modulus Method," utilizing experimental data obtained from tests performed on model specimens. This method of analysis is extended into the perforated region, and the long-term stresses in the ligaments are assessed. The proposed method is accomplished by an application of the Finite Element Method for the elastic plane stress case. Comparisons of experimental results and theoretical predictions by the proposed method, and other analytical methods, are made for a series of perforated concrete slabs subjected to radial in-plane loading: 10342 kN/m^2 (1500 psi), and uniform elevated temperature of 80°C. The investigation, though in general terms, could be applied to the perforated region of cylindrical pressure vessels for nuclear reactors. (auth)

26035 (CONF-730942-P3, pp vp Paper H 2/3) INVESTIGATIONS ON ULTIMATE LOAD DESIGN OF PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS. Schimmelpfennig, K.; Hansson, V. (Ruhr-Univ., Bochum, Ger.). 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

According to conventional prestressed concrete engineering practice, ultimate load safety has to be calculated in the design of prestressed concrete pressure vessels for nuclear reactors. Because of complicated geometry and large wall dimensions, this analysis cannot be performed with normally used methods, since the failure mechanism cannot be predicted by well established criterions as for usual prestressed concrete constructions. For earlier vessel projects, ultimate load tests on large scale concrete models together with considerably simplified calculations of kinematic rigid body mechanisms were used to demonstrate a sufficient safety factor. Further development of the rigid body method and preparation of a computer program for simple handling led to a design tool which is still useful in estimating ultimate load capacity of vessels, particularly in early design stages. Some examples concerning that method are presented. More accurate analysis, especially in order to investigate the development of the failure mechanism due to progressive cracking without model testing, may be done by using numerical computer programs for three-dimensional continua, for example the dynamic relaxation technique. By application of a material law taking account of the behavior of concrete in a cracked state, it is possible to predict the crack propagation towards the probable failure model. This is demonstrated by a calculation of the THTR vessel, which is in good agreement with experimental results of the THTR-1:5-model. With this information on the failure mechanism it is furthermore possible to use three-dimensional continua computer programs for quantitative statement of ultimate vessel safety. Single cracks are chosen in accordance to the above determined crack propagation at the haunches and in the wall with consideration of transverse reinforcement. Coaxial and circumferential cracking may be corrected by a step by step calculation corresponding to stresses in the construction. Stress redistributions due the concrete plastification may be considered. Results of a calculation example based on THTR vessel geometry show, that in the cylindrical region elastic deflections are small compared with the total displacements, i.e., rigid body behavior is predominant, whereas in the plane and slabs a pressure dome originates. From the vessel displacements produced by utlimate pressure the maximal prestressing steel stresses can be evaluated. An important advantage of this method compared with rigid body mechanism investigations is that no difficulties with the compatibility of the system arise. (auth)

26036 (CONF-730942-P3, pp vp Paper H 2/7) STRUCTURAL ANALYSIS, SAFETY CONSIDERATIONS, AND ANALYSIS OF THE PROCESS OF FAILURE OF PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS. Nesitka, A.; Walluschek-Wallfeld, W. (Reaktorbau Forschungs- und Baugesellschaft mbH and Co., Seibersdorf, Austria). 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The calculation of the Prestressed Concrete Pressure Vessel for the "Gemeinschaftprojekt Heliumkreislauf" which is to be constructed and explored at the Forschungszentrum Seibersdorf of the Österreichische Studiengesellschaft für Atomenergie is described. This vessel will be erected this year and will have a hot liner. The execution of the precalculation is discussed and a simple method is presented to calculate with a rather small amount of computer time. This method involves conditions of equilibrium and compatibility of stresses taking into consideration creep of concrete including the influence of temperature, the influence of cracks, and the elastic-plastic behavior of prestressed and mild steel. The calculation by the method of finite differences and iterative solution of the system of equations is compared with finite element method with direct Gauss elimination and the method used and mentioned above regarding computer time and accuracy. The very extraordinary conditions of the project, especially the high temperatures of the liner and the prestressed concrete make it necessary to consider the change in behavior of the material, especially Young's Modulus, strength and creep behavior, in executing the calculation. The execution of the construction is essentially destined and outlined by these facts. The calculation has to follow the execution of the construction. Standards and recommendations of international institutions demand integrity of the liner and security against failure of the vessel. However, stress conditions vary as a result of cracks in the outer parts of the insulating and prestressed concrete wall of the vessel caused by hypothetical increase of internal pressure. In order to calculate these influences it is necessary to develop methods so that cracks and thereby induced variations of stresses as well as plastification of tendons can be taken into consideration. The development concerning these problems is presented. (auth)

26037 (CONF-730942-P3, pp vp Paper H 3/4) PROBLEMS IN DESIGNING FOR COMPLEX STRESS STATES IN PRESTRESSED CONCRETE PRESSURE VESSELS WITH PARTICULAR REFERENCE TO CYLINDRICAL END SLABS AND CLOSURES. Garas, F. K.; Crittenden, G. M. (Taylor Woodrow Construction Ltd., Southall, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Complex stress states exist in various members of cylindrical prestressed concrete pressure vessels including end slabs and boiler closures. Such members are geometrically deep in relation to their span with span to depth ratios in the range of 0.5 to 4.0. High operating pressures result in high shearing forces which are controlled by the application of hoop prestress. Under this combination of stresses, it is difficult to achieve an accurate ultimate load analysis because of the lack of suitable failure criteria for concrete. In addition, the designer's problem is often magnified by the discontinuities in the structure, e.g., penetrations, cooling tubes, etc. The only solution, therefore, is to undertake model analysis. An experimental program completed recently, to extend our understanding of the failure of concrete under biaxial restraint and high shear stresses is described. A series of model tests to examine the short and long term behavior of the boiler closures for the Hartlepool and Heysham vessels are discussed. The closures, which have nine major penetrations, form an important part of the concept of removable pod boiler systems. Parametric studies on small prestressed concrete elements were used to examine the failure of deep end slabs. The contributions of both the compression zone and the aggregate interlock in resisting shear forces have been assessed. Major variables are loaded diameter to depth ratio, loaded diameter to shear span ratio and level of hoop prestress. The results are then related to extensive model studies previously carried out on end slabs. Sixty $^1/_{10}$th scale models were tested to determine the likely effects of various parameters including amount of hoop prestress, support system and effect of penetration liners on the strength of the closure. In addition, to confirm the behavior of the final design, four fully representative $^1/_3$rd scale models were subjected to short and long term over load tests. Typical behavior is presented and discussed. Finally, model behavior is compared with a dynamic relaxation computer analysis. (auth)

26038 (CONF-730942-P3, pp vp Paper H 4/4) PERFORMANCE OF THE WYLFA NUCLEAR PRESSURE VESSELS DURING COMMISSIONING IN RELATION TO DESIGN ANALYSIS. Browne, R. D.; Smith, J. R.; Bamforth, P. (Taylor Woodrow Construction Ltd., Southall, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The two prestressed concrete pressure vessels which house the reactors at the 1180 MW Wylfa Nuclear Power Station remain the largest to be constructed to date. Fundamental research into concrete properties, extensive model and component analysis, and the development of analytical techniques were major factors in achieving the final design of these structures. During construction, each vessel was comprehensively instrumentated in a similar manner, and the data obtained have already permitted detailed examination of their performance under the two significant early loadings of prestress and proof pressure. Both vessels have subsequently passed through the commissioning phase and are now in service. During this phase the pressure and thermal loading histories were complex, and the instrumentation provided further data on the resultant strain and temperature distributions. The problems in relating the behavior observed to that which might reasonably be predicted analytically are discussed. The vessels and instrumentation system are discussed, and the functional behavior of the instruments during the life of the vessels so far is appraised in order to assess the reliability of the recorded data. Typical strain histories are then presented and discussed in relation to the loadings imposed on each vessel. Details are given of the test program undertaken in the laboratory to establish the in-situ performance of the vessel concrete. The important factors involved in employing the resultant concrete data in the design analysis are defined and the relationship between predicted and observed behaviors is examined and discussed. Finally, the value and limitations of alternative methods of analysis used to define the realistic behavior of vessels are identified and discussed in relation to the needs of the designer to define long term serviceability and tolerances. Tentative recommendations are made as to the directions in which future work in this field should proceed. (auth)

26039 (CONF-730942-P3, pp vp Paper H 5/4) DESIGN OF PENETRATION-LINER JUNCTIONS FOR PRESTRESSED CONCRETE PRESSURE VESSELS. Tate, L. A.; Bellwood, G. N.; Hart, B.; Bailey, M. F. (British Nuclear Design and Construction Ltd., Whetstone, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The liners and penetration liners for prestressed concrete pressure vessels are constrained to follow the movements of the concrete structure and are thus subjected to high strains, often beyond yield, but are not in general required to carry unaided the pressure or other applied loads. The design of the liners at discontinuities, such as penetration-liner junctions, therefore requires a different approach to that appropriate to similar features in steel pressure vessels, although many of the same criteria and analytical methods are applicable. The junction design must ensure the integrity of the main liner shear connectors, tie-backs and cooling pipes, prevent plastic strain accumulation, and limit strain ranges to prevent fatigue failure. This can be achieved either by reinforcement in the form of pads or nozzles akin to that provided in steel pressure vessels, or by the provision of substantial anchorage of the main liner to the concrete around the junction. Both methods have been used in the design of the Wylfa, Hartlepool and Heysham liners. The design criteria and analysis methods employed for different types and sizes of penetration in these vessels are discussed. Analysis methods for junctions with axisymmetric geometry and loading present little difficulty. For the gas duct junctions of the Hartlepool and Heysham vessels neither the geometry nor the loading is even approximately axisymmetric. For the Heysham duct junction an analysis has been carried out by means of the ASKA finite element computer program, using TRIB3, HETET4, and FLA2 elements, which enabled the asymmetric geometry and loading to be adequately simulated. This analysis is described and the results compared with an approximate method used in the Hartlepool design. (auth)

26040 (CONF-730942-P3, pp vp Paper H 5/5) ASSEMBLING AND FIXING OF CERAMIC INSULATION STRUCTURES IN THE CONCRETE VESSELS OF HIGH TEMPERATURE REACTORS. Felten, P. (CEN de Saclay, Gif-sur-Yvette, France). 1973. (In French).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A new concept using cast fused silica is proposed to design thermal barriers of a high temperature reactor as well for the vertical walls of the hot plenum as for the hot ducts. Cast fused silica has already been used in H.T.R.'s for horizontal structures. For vertical walls a new concept based on the ordinary furnace construction techniques where the silica blocks are held together by a silica cement is proposed. A test rig has been constructed to investigate the behavior of such a construction versus time and under thermal cyclings. The rig is made of two cast silica walls in front of each other with a heating resistor between them which allows the hot face temperature to go as high as 850°C. The cold face is kept at a low temperature so that the temperature gradient across the walls is about the same as that of an actual thermal barrier in a reactor. For the hot duct insulation a different system is used. A cast silica ring is maintained in the steel cylinder defined by the liner by the mean of a closed metallic sheet, so called "annular jack", which is injected with a pressurized fluid material. This material solidifies after a while and so the "jack" is kept under pressure. This system allows the gap between the silica ring and the liner to remain closed and puts a prestress on the silica ring. When the internal face of the silica ring is heated up this prestress balances the tensile stresses on the outer face of the silica ring. A test ring has also been constructed to verify the behavior of this concept versus time and with thermal cyclings. The rig is designed exactly as described here with an annular resistor to heat up the internal face of the silica ring up to 850°C, the cold face being kept at a low temperature. (auth)

26041 (CONF-730942-P3, pp vp Paper H 5/6) RESPONSE OF FIBROUS PRESTRESSED CONCRETE PRESSURE VESSEL INSULATION SYSTEMS TO TYPICAL NOISE SPECTRA. Jones, E. A. C.; Hartley, W.; Hopkins, I. H. G. (Nuclear Power Group Ltd., Warrington, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The way in which the acoustic and flow induced pressure fluctuation spectra have been predicted for the environment within the Advanced Gas-cooled Reactors being built by The Nuclear Power Group, and how these spectra have been used to estimate the vibration responses of the vessel thermal insulation containment structures is illustrated. Within a reactor, acoustic pressure fluctuations affect all areas and are determined largely by the noise emissions from the gas circulators. Measurements made on early gas-cooled reactors, on model and production circulators, and in the reactors during construction and commissioning have been used to estimate the acoustic spectra under all operating conditions. Flow induced pressure fluctuations are only important in specific areas and the spectra have been estimated from the results of flow tests at atmospheric and at high gas pressure on both fractional and full scale models of the relevant parts of the reactor. The thermal insulation design for the TNPG AGRs uses a ceramic fiber blanket insulant. A criterion has been derived for the allowable vibration of structures in contact with this blanket and the response of insulation assemblies has been determined either in high intensity noise chambers or under high turbulence flow conditions to ensure that the criterion has been met. Wherever possible, tests have been carried out under conditions as near as possible to those predicted for the reactor and analytical models have been used to corroborate the test results. (auth)

26042 (GULF-GA-A-12477) PUBLIC SERVICE COMPANY OF COLORADO 330-MW(e) HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending December 31, 1973. (Gulf General Atomic Co., San Diego, Calif. (USA)). 31 Jan 1974. Contract AT(04-3)-633. 46p. Dep. NTIS $4.50.

The research and development program for the Public Service Company of Colorado 330-MW(e) High-temperature Gas-cooled Reactor is reviewed. Studies of nuclear analysis of the fuel cycle, fuel zoning, and power shaping are included. The fuel development and fuel element proof testing programs include demonstration testing of the performance of test fuel elements by means of irradiation at expected operating temperatures and capsule irradiation tests of production fuel. (auth)

26043 (GULF-GA-A-12559) PUBLIC SERVICE COMPANY OF COLORADO 330-MW(e) HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report For the Period Ending March 30, 1973. (Gulf General Atomic Co., San Diego, Calif. (USA)). 30 Apr 1973. Contract AT(04-3)-633. 29p. Dep. NTIS $3.50.

The research and development program for the Public Service Company of Colorado 330-MW(e) High-temperature Gas-cooled Reactor is reviewed. Studies of nuclear analysis of the fuel cycle, fuel zoning, and power shaping are included. The fuel development and fuel element proof testing programs include demonstration testing of the performance of test fuel elements by means of irradiation at expected operating temperatures and capsule irradiation tests of production fuel. Studies covering the components of the steam generator under operating conditions are included. Experimental procedures and results are discussed and, where appropriate, the data are presented in tables and graphs. More detailed descriptions of experimental work are presented in topical reports, and these are listed at the end of the report. (auth)

26044 (GULF-GA-B-12406) CROSS SECTIONS FOR THE FORT ST. VRAIN INITIAL CORE. Marshall, A. C. (Gulf General Atomic Co., San Diego, Calif. (USA)). 1 Nov 1972. Contract AT(04-3)-633. 29p. Dep. NTIS $3.50.

The calculational procedure and the results of broad group cross section calculations for the Fort St. Vrain initial core are presented. The cross sections are used in diffusion theory codes to perform a nuclear analysis of the core. Cross section sets were obtained through the use of the GGC-5 computer code. GGC-5 calculates the fine group neutron spectrum in a heterogeneous cell and provides cross sections averaged over the cell and energy broad groups. 10 references. (auth)

26045 (GULF-GA-B-12697) FUEL FABRICATION ACCEPTANCE REPORT FSV: INITIAL CORE. Kapernick, R. J.; Nirschl, R. J. (Gulf General Atomic Co., San Diego, Calif. (USA)). 1 Dec 1973. Contract AT(04-3)-633. 118p. Dep. NTIS $5.45.

The fabrication of the Fort St. Vrain initial core is described. Detailed summaries of the final fuel element metal loadings and other properties are given. Problems that occurred during fabrication and their resolutions have been given special attention, including the results of analyses made prior to their adoption. A final substantiation for the Fort St. Vrain initial core was provided by a full-core, three-dimensional analysis considering control rod insertion and fuel depletion and with explicit representation of the as-built fuel elements. The calculated power distributions from the three dimensional analysis are well within the limits specified for the reference design. During fabrication of the initial core fuel elements, some difficulties with assayed quantities of uranium and thorium were encountered. These difficulties resulted from changes in the fuel rod standards used in assay equipment calibration and in the techniques employed for assaying fuel particles and fuel rods. As a result the apparent values for the average metal loadings for some fuel rods and fuel elements changed. For certain blends some already-assembled fuel elements were outside the tolerances given in the fuel specification. A study was undertaken to make recommendations on the disposition of already-fabricated fuel and adjustments for the remainder of fuel fabrication. This study focused on utilizing, as much as possible, already-fabricated fuel without compromising the performance of the core. A variety of adjustments were considered and used in some instances, but the most successful method was the imposition of a layer location on fuel elements. By use of this additional core assembly requirement, a distribution of high metal load and low metal load fuel elements was obtained that assured that power perturbations would be small and localized and that temperature perturbations would be small and confined to axial layers where temperatures are nominally low. (auth)

26046 (NP-19956) DUNGENESS B NUCLEAR POWER STATION. (Central Electricity Generating Board, Kent (UK). Dungeness A and B Nuclear Power Stations). 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

Descriptions and technical data for the power plant, reactors, fuel elements, control and instrumentation and associated equipment are presented. The objects of the AGR concept are to supply steam at conditions comparable with those in a modern fossil-fired power station, to provide plant which is considered safe enough to site near centres of population and to operate with very high availability. The need for high-temperature steam is met by using ceramic fuel clad in stainless steel. The high standard of safety is achieved by using a pre-stressed concrete pressure vessel to contain the reactor and boiler units. High availability is ensured by provision for on-load refueling of the reactors. (UK)

26047 IMPROVEMENTS IN AND RELATING TO GAS COOLED NUCLEAR REACTORS. Bilsborough, R.; Proudlove, M. J. (to Nuclear Power Group Ltd.). British Patent 1,339,538. 5 Dec 1973. Filed Date 31 Dec 1969. 3p.

In the event of main power supply failure the gas circulators of gas cooled reactors are operated by emergency electrical supplies and as a result gas flow through the reactor may be reduced to as little as 20% of the normal flow. Under these conditions, although the reactor will have been shut down, the temperature of the gas leaving the core may not fall significantly for 10 to 15 min. because of the heat capacity of the core. Since the reactor is not providing much power the boilers generate little steam and as a consequence high steam and metal temperatures in the heat exchangers are difficult to avoid. In the arrangement described a bypass system is incorporated through which a controlled amount of the coolant gas can be directed when it is required to bypass the normal path, the bypass system being located in a lower temperature region of the reactor than the normal path. The gas leaving the bypass system is mixed with the gas leaving the core from the normal path so as to reduce the temperature of this gas, and the mixed gases are directed to heat exchangers before being returned to the reactor core. Means are provided for adjusting the amount of bypassed cooling gas, thereby adjusting the temperature of the mixed gases directed to the heat exchanger. The bypass system may comprise ducts located in an outer portion of the graphite moderator, with the flow through the ducts controlled by valves operable in response to a predetermined operating condition. The bypass ducts need not be located in the core, but can, for example, be located in the walls of the reactor vessel, or lie within the heat exchanger space. (UK)

26048 PREPARATION OF ALL PRESENT FUEL AND ABSORBER PARTICLE TYPES FOR HIGH TEMPERATURE FUEL ELEMENTS IN A PILOT PLANT. Bildstein, H.; Foerthmann, R.; Huschka, H.; Kadner, M. Technical Meeting No. 3/14. Basel; Nuclex (1972). 7p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

By combination of several wet chemical processes developed by NUKEM, KFA and SGAE for production of fuel kernels containing U or Th, respectively absorber kernels containing B, a so-called "wet kernel line" (NKL) was developed, by which all acute kernel types for high temperature reactors can be produced. These are, in the first place, $(U,Th)O_2$-kernels of high density for the AVR and THTR reactors, which are produced in a pilot plant with a throughput of 10 kg per day and which from 1972 on will be produced in production scale; further, kernels of $(U,Th)C_2$, ThO_2, UO_2, UC_2, $UO_2 + xC$, and carbonate containing B, of different porosity and in the range between 100 and 1000 μm size. (auth)

26049 300-Mwe THORIUM-HIGH-TEMPERATURE NUCLEAR POWER PLANT (THTR) AND THE DEVELOPMENT OF HIGH TEMPERATURE REACTORS IN THE BRD. Glahe, E. (Hochtemperature-Kernkraftwerk, GmbH, Uentrop, Ger.); Oehme, H.; Schloesser, J.; Shilling, W. F.; Thurnher, K. Technical Meeting No. 3/5. Basel; Nuclex (1972). 21p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The 15 MW(e) AVR experimental pebble bed reactor has been in operation since 1968. The operation has been very satisfactory.

In May 1971 the construction of the 300 MW(e) THTR Prototype Nuclear Power Plant was started; it is proceeding according to schedule. In late 1973 it is envisaged to submit an offer for a 1160 MW(e) HTR demonstration power plant. The further development of the HTR-line is directed to the direct cycle with a helium turbine and to the generation of process heat. (auth)

26050 ROLE AND DEVELOPMENT OF NUCLEAR GRAPHITE FOR GAS COOLED REACTORS, WITH PARTICULAR REFERENCE TO THE HIGH TEMPERATURE REACTOR. Middleton, P. M.; Moore, R. W. Technical Meeting No. 3/11. Basel; Nuclex (1972). 16p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1973).

The developments that have taken place on graphite in the United Kingdom in order to meet both the demands placed on it by more advanced reactor types and the increase in knowledge about its behavior under irradiation are described. (7 references) (auth)

26051 HTR-BNDC's LATEST DESIGN AND SUPPORTING DEVELOPMENT IN THE UNITED KINGDOM. Joyce, A. J.; Thorn, J. D. Technical Meeting No. 3/1. Basel; Nuclex (1972). 17p.

From international industries fair; Basel, Switzerland (16 Oct 1972).

British Nuclear Design & Construction submitted a tender to the U.K. Central Electricity Generating Board in April 1971 for a nuclear power station based on an H.T.R. Since that time B.N.D.C. has made improvements to its design, including the gas circuit arrangement, boilers, and steam cycle. Some of these improvements are described as well as an alternative fuel element design for which the reactor is suited. An outline account is given of supporting fuel and materials development work being carried out in the United Kingdom. (auth)

26052 HTGR: STATUS IN THE U. S. AND FUTURE UNIQUE POTENTIAL. Goodjohn, A. J.; Koutz, S. L.; Fischer, P. U.; Shilling, W. F. Technical Meeting No. 3/3. Basel; Nuclex (1972). 23p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The development of the HTGR program leading to acceptance of the system by U. S. utilities is reviewed. Reference is made to the operational performance of Peach Bottom I HTGR and to the construction of the 330 MW(e) Fort St. Vrain station. Features of the large commercial HTGR now being marketed in the US are outlined. The future potential of the HTGR system including the direct cycle gas turbine and the process heat application is discussed. (auth)

26053 HIGH TEMPERATURE REACTORS IN FRANCE. Pelce, J.; Brisbois, J.; Delpeyroux, P.; Patarin, L.; Audinet, M.; Baschwitz, R.; Martin, G. Technical Meeting No. 3/4. Basel; Nuclex (1972). 26p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

In the field of fuel, the CEA, and French industry, have developed, in their research laboratories and workshop, the techniques and the means to manufacture and test different types of fuel elements. Many irradiations in experimental CEA reactors are in progress or completed and will provide the information needed to foresee the behavior of the fuel element and its components. Parallel studies are being carried out at the CEA to intercompare the different fuel elements and fuel cycles from the viewpoint of yields and cost of the cycle. Where the nuclear boiler components are concerned, experience gained in the field of gas-cooled reactors gives France the competence and test means necessary to solve certain problems without difficulty. Work is devoted mainly to research on components specific to HTR'S, such as heat insulation and high-power coolant loop. (auth)

26054 ARE HIGH TEMPERATURE REACTORS NOW OF INTEREST TO THE UTILITIES. Haenni, H. P.; Kierulf, B. C. Technical Meeting No. 3/6. Basel; Nuclex (1972). 21p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

There is an increasing interest in the HTR (High Temperature Reactor) among the utilities. The status of the HTR is presented, comparing significant data with the water reactors and indicating where development and testing is still required. Of particular interest is the operating performance of the prototype HTR awaited. It is concluded that the HTR is an interesting reactor system and can compete with the approved systems, if said operating experience of prototype reactors corresponds to the expectations. (20 references) (auth)

26055 POD BOILER VESSELS FOR HARTLEPOOL, HEYSHAM, AND THE FUTURE. Burrow, R. E. D. Technical Meeting No. 3/7. Basel; Nuclex (1972). 17p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Progress in the design and construction of the Hartlepool and Heysham prestressed concrete pressure vessels is described. Future applications of the multi-cavity vessel are analyzed. (6 references) (auth)

26056 NEW STEAM PRODUCTION CONCEPT FOR GAS-COOLED REACTORS. Beckmann, G.; Fritz, K.; Lippitsch, J. Technical Meeting No. 3/9. Basel; Nuclex (1972). 13p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

A new steam generator concept for gas cooled reactors has been developed avoiding the disadvantages of conventional types, i.e. fretting and deleterious vibrations. It is characterized by longitudinally finned tubes welded to form concentrically arranged membrane type heat transfer surfaces. (18 references) (auth)

26057 STATE OF DEVELOPMENT OF FRENCH TECHNIQUES IN THERMAL PROTECTION MATERIALS FOR NUCLEAR REACTORS. Naudin, P.; Jannot, M.; Costes, D.; Cornille, Y.; Costaz, J. L.; Jolas, P.; Lida, M.; Merot, J. P.; Ollagnon, A. Technical Meeting No. 3/10. Basel; Nuclex (1972). 15p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Recent French research and development works relative to thermal barriers for HTR include: a theoretical and experimental work on the effects of forced and free convection on thermal insulations; the experimental loops operating under helium pressure; and the development of insulations made of metallic grids, mineral wools and ceramics. (auth)

26058 IMPROVEMENTS AND DEVELOPMENTS IN THE FUEL ELEMENT FABRICATION FOR HIGH TEMPERATURE REACTORS. Herrmann, F. J.; Hrovat, M.; Huschka, H.; Rachor, L.; Venet, P. Technical Meeting No. 3/12. Basel; Nuclex (1972). 14p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

A distinction between spherical and prismatic type of fuel elements for high temperature reactors (HTR) is described. Concerning the spheres, some improvements of the fuel element properties and the advanced production technique are described. In addition a short review above several advanced prismatic fuel element designs is given. (auth)

26059 HTR FUELS AND THEIR FURTHER DEVELOPMENT. Graham, L. W.; Price, M. S. T. Technical Meeting No. 3/13. Basel; Nuclex (1972). 16p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

In the HTR a high working temperature is achieved by use of a graphite core structure, ceramic coated particle fuel and helium as coolant. Almost any combination of fissile and fertile fuel can be employed. It must therefore be expected that several different types of HTR will emerge and care must be taken not to confuse HTR's under development with systems which are already commercially viable. The development of the HTR is reviewed and its commercial breakthrough in the USA with cumulative sales of 5400 MW(e) surveyed. Satisfactory production scale fuel for present day applications already exists. The basic forms of core design are examined—the pebble-bed system and the prismatic core. Some of the different particle designs in prismatic reactors are contrasted to illustrate the inherent flexibility of the HTR. The directions for future work on fuel are discussed. It is concluded that the main pressures will be to increase the operating margins, to reduce fabrication costs, simplify quality assurance and achieve greater overall optimization. (62 references) (auth)

26060 MAIN FEATURES OF DIRECT CYCLE HELIUM GAS TURBINES INTEGRATED WITH A HIGH TEMPERATURE REACTOR. Buryło, P. Technical Meeting No. 6/7. Basel; Nuclex (1972). 24p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The main features and advantages of direct cycle helium gas turbines integrated with a high temperature reactor are presented. The proposed design concept is based on a logical extension of existing knowledge and experience on currently built gas cooled reactors and industrial gas turbines. The direct cycle gas turbine offers many advantages in the form of high reliability, safety and simplicity; it emerges as a potential competitor to the main power generation prime mover, the steam turbine. (auth)

26061 HELIUM GAS TURBINES FOR HIGH TEMPERATURE REACTORS. Endres, W. Technical Meeting No. 6/8. Basel; Nuclex (1972). 15p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

26062 DESIGN AND IRRADIATION OF HTR FUEL. Gaube, M.; Aerts, L.; Bairiot, H.; Vangeel, J. Technical Meeting No. 3/15. Basel; Nuclex (1972). 32p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The contribution of the Belgian R & D program is applicable to the different HTR fuel cycles presently pursued. Part of the work is performed to back-up the plutonium utilization in power reactors. Our low enriched uranium fuel program consists mainly of irradiations demonstrating the adequacy of the fuel and of the design methods. (14 references) (auth)

26063 PREPARATION OF URANIUM RODS BY CONTINUOUS CASTING UNDER VACUUM. Guichard, C.; Guilleray, J.; Soret, J. C. Technical Meeting No. 5/16. Basel; Nuclex (1972). 10p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

S.I.C.N. is developing a new short process for the manufacture of uranium fuel rods of Gas Graphite Reactors. The design for a vacuum continuous casting process with continuous withdrawal of the ingot from the vacuum chamber to the open air is described. Rods cast with this process are of superior quality and economic advantages are important. (auth)

26064 HELIUM TURBINES FOR HIGH-TEMPERATURE REACTORS. Knuefer, H. (Arbeitsgemeinschaft Versuchs-Reaktor GmbH, Juelich, Ger.). Brennst.-Waerme-Kraft; 25: No. 12, 464-471 (Dec 1973). (In German).

From joint meeting of the VDE and VDI; Dusseldorf, Ger. (17 Oct 1972).

The designs of turbines with air and helium as working media are compared, and volume flow, mass flow, sound velocity, stage number, and other characteristics are individually dealt with. Similar comparisons are made regarding connecting lines and heat exchangers. The combination of the helium turbine with high-temperature reactors is described. Problems of the integrated and non-integrated method of single cycle plants and helium turbines, the use of dry cooling towers and the development of helium turbines are discussed. (GE)

26065 DESIGN OF 2300 MW(e) TWIN HIGH TEMPERATURE GAS-COOLED REACTORS FOR THE PHILADELPHIA ELECTRIC COMPANY. Gibbons, J. P. (Philadelphia Electric Co.); Waage, J. M.; Sieving, K. W. Nucl. Eng. Des.; 26: No. 1, 27-37(1974).

The basic design features of a 2300 MW(e) twin high temperature gas-cooled reactor (HTGR) power plant are described. The reactor core consists of vertical columns of hexagonal graphite fuel-moderator elements and graphite reflector blocks which are grouped into a cylindrical array and supported by a graphite core support structure. Reactivity control is accomplished by means of 146 control rods. The distribution of helium coolant flow through the core is controlled by variable orifice valves. Each of the six primary coolant loops is equipped with a helium circulator. The main steam/water section of each steam generator consists of a single helical tube bundle arranged in an annulus around the center duct. A core auxiliary cooling system is provided to furnish an independent means of removing reactor afterheat. The inherent safety characteristics and the design safety features of the large HTGR are discussed. Station arrangement, steam cycle and twin turbine generators, plant performance and control, containment and fuel handling, and environmental controls, are described. (auth)

26066 FORT ST. VRAIN NUCLEAR GENERATING STATION CONSTRUCTION AND TESTING EXPERIENCE. Habush, A. L. (General Atomic Co., San Diego, CA); Walker, R. F. Nucl. Eng. Des.; 26: No. 1, 16-26(1974).

The 330 MW(e) Fort St. Vrain Nuclear Generating Station uses a uranium–thorium fuel cycle; graphite for the moderator, fuel cladding, core structure, and reflector; and helium for the primary coolant. Significant design features are the prestressed concrete reactor pressure vessel, once-through modular steam generators with integral superheaters and reheaters, steam-driven axial flow helium circulators, and hexagonal graphite fuel elements incorporating improved carbon-coated fuel particles. Plant features, construction procedures, preliminary operating tests, fuel loading and startup procedures, and operator training programs are described. (auth)

26067 CASE FOR GAS COOLING. Fortescue, P. (Gulf General Atomic Co., San Diego, CA). Nucl. Eng. Des.; 26: No. 1, 3-8(1974).

The technological motivations for gas cooling of nuclear power reactors are: pure single-phase operation; low neutron absorption and moderation; chemical and radioactive inertness in the case of helium; transparency; total coolant loss impossible — only depressurization; and low total stored energy. The needs of the fast breeder reactor are discussed. More generally, it is pointed out that gas cooling allows full utilization of the most modern steam plant development, with substantial advantages both to plant cost and efficiency. It also makes feasible the integral PCRV type of construction. The prospect of future combination with the gas turbine offers a unique field for future reduction of plant cost. (auth)

26068 OPERATING EXPERIENCE OF THE PEACH BOTTOM ATOMIC POWER STATION. Birely, W. C. (Philadelphia Electric Co.). Nucl. Eng. Des.; 26: No. 1, 9-15(1974).

The Peach Bottom Atomic Power Station Unit No. 1 is the first installation of a high temperature gas-cooled power reactor in the United States. This 40 MW(e) prototype power reactor plant has operated very successfully at full power since it was placed in commercial operation on the Philadelphia Electric Company system in June 1967. Following a description of the main features of the primary system of the Peach Bottom plant, the reactor plant operation history is outlined and the performance experience is discussed. (auth)

26069 MATERIALS AND DESIGN CONCEPTS OF GAS-COOLED REACTOR SYSTEMS. Landis, J. W.; Watson, J. F. (Gulf General Atomic Co., San Diego, CA). Nucl. Eng. Des.; 26: No. 1, 38-57(1974).

The family of gas-cooled reactors being developed in the United States by Gulf General Atomic consists of the steam-raising and direct cycle versions of the high temperature gas-cooled reactor (HTGR) for electric power generation, the hydrogen-producing HTGR for chemical process applications, and the gas-cooled fast reactor (GCFR), a high gain breeder. The underlying design concepts that are common to all of these reactors are described. These design concepts are related to the choice of both structural and fuel materials for the wide variety of environmental conditions encountered throughout the world. Interwoven with this discussion are typical examples of the interaction of design activities and materials selection required to give a reactor system of maximum safety and reliability, favorable environmental features, and minimum cost. (auth)

26070 HTGR PLANT SAFETY DESIGN BASES. Wessman, G. L.; Moffette, T. R. (Gulf General Atomic Co., San Diego, CA). Nucl. Eng. Des.; 26: No. 1, 78-102(1974).

The high temperature gas-cooled reactor (HTGR) has inherent and design safety features that are significant and unique, requiring a number of safety criteria and approaches that differ markedly from other reactor types. The design of HTGR plants that have been built and are being offered in the United States is described. The safety considerations involved in the design of the plants being offered are discussed. The unique features, their development, and their effects on safety criteria are described. The design bases of the prestressed concrete reactor vessel (PCRV) are given particular attention. Operating characteristics of the HTGR and plant response to transient conditions are discussed. The design-basis depressurization accident evolution and related HTGR safety requirements are discussed. Characteristics of the HTGR with respect to technical specifications are discussed, with particular emphasis on the PCRV and the core safety limit. 9 references. (auth)

26071 HTGR FUEL AND FUEL CYCLE. Dahlberg, R. C.; Asmussen, K.; Lee, D.; Brooks, L.; Lane, R. K. (Gulf General Atomic Co., San Diego, CA). Nucl. Eng. Des.; 26: No. 1, 58-77 (1974).

Some of the basic characteristics of the HTGR fuel are described with emphasis on the 1160 MW(e) plant now being offered commercially by Gulf General Atomic. Some of the aspects of the fuel cycle which are unique to the HTGR are discussed. The fuel cycle is based on highly enriched (93%) uranium for the initial and the make-up fissile material; thorium for the fertile material, with the bred ^{233}U being recycled at the earliest opportunity. The fuel elements consist only of ceramic materials with the thorium/uranium carbides or oxides in the form of coated particles. 8 references. (auth)

26072 HTGR PLANT DYNAMICS ANALYSIS UNDER ACCIDENT CONDITIONS. Baxter, A. M.; Swanson, L. L. (Gulf General Atomic Co., San Diego, CA). Nucl. Eng. Des.; 26: No. 1, 103-117(1974).

Important features of high temperature gas-cooled reactor (HTGR) systems related to plant dynamics and accident analysis are discussed. Because of the basic simplicity of the HTGR system, it is possible to analyze the full reactor plant (core, helium circulators, steam generators and reheaters, feedwater controls, turbine controls, and plant protective action) in a single computer code. Representative dynamics analysis is presented for the Fort St. Vrain Power Station. 8 references. (auth)

26073 DESIGN AND DEVELOPMENT OF A STEAM TURBINE DRIVEN CIRCULATOR FOR HIGH TEMPERATURE GAS-COOLED REACTORS. Cavallaro, L.; Yampolsky, J. (Gulf General Atomic Co., San Diego, CA). Nucl. Eng. Des.; 26: No. 1, 135-157(1974).

Design optimization of high temperature gas-cooled power reactors with integration of the entire primary coolant system in a prestressed concrete reactor pressure vessel (PCRV) leads to stringent power, size, and environmental requirements for the primary coolant circulation equipment. To meet these requirements, the series steam turbine helium circulator (SSTHC) was conceived and developed by Gulf General Atomic. The SSTHC consists of a single stage axial-flow helium compressor driven by a single stage steam turbine. The compressor and the drive turbine are integrally attached to a single vertical shaft and overhung from a central bearing and seal housing. The drive turbines are in series with the power-producing main steam turbine. The design points of the compressor, drive turbine and auxiliary Pelton wheel drive, as well as the design requirements for the bearings and seal system are presented. A general outline of the SSTHC development program carried out at Gulf General Atomic is given. The following areas are included in the development program: aerodynamics, compressor noise, primary coolant shutoff valve, water bearings and rotor dynamics, seals, blade vibration, and disk catcher. Further, a comprehensive series of transient tests on a circulator have been carried out. (auth)

26074 DESIGN OF THE FORT ST. VRAIN STEAM GENERATOR. Quade, R. N.; Hunt, P. S.; Schuetzenduebel, W. G. (Gulf General Atomic Co., San Diego, CA). Nucl. Eng. Des.; 26: No. 1, 118-134(1974).

The steam generators for the Fort St. Vrain nuclear power plant are the first application in the United States of once-through boiler design coupled with a high temperature gas-cooled reactor. They contain many design features which are unique for this type of component. Since they are an integral part of the primary system and completely enclosed by the prestressed concrete reactor vessel, they must be removable as well as fit the space available for penetrations. These requirements made the once-through boiler principle a logical choice. Multi-start helically wound tubes supported by perforated plates in a star-shape arrangement resulted in an extremely compact design. The helium inlet temperature of 1427°F and steam temperatures of 1005°F main and 1001°F reheat required unique solutions in terms of flexibility and cooling of support systems and selection of insulation materials and design. Operation in a helium atmosphere without a protective oxide layer called for materials with good wear protection characteristics where parts may experience relative motion. Stabilizing orifices, externally adjustable at the steam generator inlet, plus essentially equal tube lengths for each of the many parallel circuits are utilized to balance circuit performance. To minimize gas bypass flows, special gas seals are provided around individual tube bundles. Field erection time was minimized by developing an upper and a lower module assembly and joining them after erection in the reactor vessel. (auth)

26075 HTGR GAS TURBINE PLANT WITH DRY AIR COOLING. Schoene, T. W. (Gulf General Atomic Co., San Diego, CA). Nucl. Eng. Des.; 26: No. 1, 170-178(1974).

The development of the HTGR gas turbine power plant as a future evolution of the HTGR is one of the most promising solutions to the interrelated power generation and environmental problems. The HTGR gas turbine can make dry air cooling economical and can make possible increased flexibility and economy in power plant siting. The simplification and size reduction of the overall plant imply lower capital costs. Cycle parameters and plant layout for a typical HTGR direct-cycle gas turbine plant of 1100 MW(e) output are described. For safety reasons all the primary equipment is integrated inside the prestressed concrete reactor vessel. Four parallel loops are contained in eight vertical PCRV cavities located around the core cavity. Alternative design configurations and parameter choices are discussed. The advantages and the development potential of the direct cycle with regard to heat rejection and cost are discussed. The possibility of profitably using the gas turbine thermal discharge for operating a seawater distillation plant is pointed out. (auth)

26076 HIGH TEMPERATURE GAS-COOLED REACTOR AS A SOURCE OF HIGH TEMPERATURE PROCESS HEAT. Quade, R. N. (Gulf General Atomic Co., San Diego, CA). Nucl. Eng. Des.; 26: No. 1, 179-186(1974).

The nuclear reactor has established itself as a future major supplier of electrical energy. The industrial market for other forms of energy, however, is almost as large and represents a new potential for the use of nuclear reactors. The high temperature gas-cooled reactor (HTGR) has been developed for commercial application in the electric power generation field. Since the HTGR is capable of delivering process heat in the temperature range of 1000−1500°F, it has many applications that would not be possible at the lower operating temperatures of water-cooled reactors. The development of the HTGR is reviewed and its salient technical features are described. Modifications to the reactor that enable it to be used as a process heat source are discussed. Specific applications are developed for coal gasification, steelmaking, and hydrogen production. (auth)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 24812, 25963, 25970, 25986, 26026, 26284, and 26312.

26077 (BARC-665) PHOTO-ELASTIC MODEL STUDIES FOR MAPP-1 REACTOR BUILDING. Kakodkar, A.; Mehra, V. K.; Kushwaha, H. S. (Bhabha Atomic Research Centre, Bombay (India). Reactor Engineering Div.). 1973. 69p. Dep. NTIS (U.S. Sales Only) $5.50.

The results are presented of photoelastic model studies conducted at RED for MAPP-1 containment. Two and three dimensional photoelasticity techniques were used to get the stress distribution. Separation of stresses was done by shear difference method. Theoretical analysis was carried out and compared with the experimental results wherever possible. (auth)

26078 CONSTRUCTION OF NUCLEAR POWER PROJECTS ABROAD. Grandy, L. G. (Montreal Engineering Co. Ltd.). pp 211-233 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

Canada has participated in the construction of two nuclear power projects abroad; the Karachi Nuclear Power Project (KANUPP) in Pakistan and the Rajasthan Atomic Power Project (RAPP) in India. Contracting for the supply of equipment and implementation of construction of these two projects is being carried out in widely different ways. KANUPP is a turnkey job, supply and construct, with Canadian General Electric Company Limited (CGE) as prime contractor. RAPP is being built by the Department of Atomic Energy of India using consultants for design, procurement and quality control services and to oversee construction. The construction of these two projects, procurement, transportation of equipment, types of contracts, review of site organizations, and some of the problems encountered are described. (auth)

26079 CANADIAN NUCLEAR PROJECTS PAVE WAY FOR SIZE INCREASE. Law, C. (Ontario Hydro, Toronto). Energy Int.; 11: No. 2, 13-15(Feb 1974).

The number of design options available to customers of the CANDU pressurized heavy-water (PHW) reactor system is in the process of being extended as Atomic Energy of Canada Ltd puts together the preliminary drawings for a 1200 MW(e) unit. Although the extrapolation from the 500-, 600-, and 750-MW(e) sizes epitomized by Pickering, Gentilly-2, and Bruce was requested by Ontario Hydro, that is to date the largest single devotee of the CANDU concept, the provincial utility is still not yet ready to order a 1200 MW(e) nuclear steam supply system for its grid. The utility is balancing two objectives: it wants to gain the economies of scale without sacrificing the reliability entailed in repeats of an existing design. It has been comparing since 1971 the cost reduction of plants identical to those previously constructed with design improvements to Bruce and with selection of the 1200 MW(e) size. Ontario Hydro is already committed to duplicating the existing units at Pickering, to building more 750 MW(e) reactors at Bruce, and to installing at least one more series of 750s at Bowmanville. (MCW)

26080 IN-REACTOR DETERMINATION OF FUEL PERFORMANCE LIMITATIONS. Rolstad, E.; Knudsen, K. D.; Hanevik, A.; Kolstad, E.; Albergamo, V. Technical Meeting No. 5/11. Basel; Nuclex (1972). 19p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

A survey of some of the most interesting fuel clad elongation, pellet stack elongation and fuel rod diameter measurements at the Halden Project is given. The results show how the different fuel design parameters, pellet length, fuel-to-clad gap, pellet end-shape, fuel density and a center hole will affect the fuel-clad mechanical interaction and dimensional changes of fuel rods. (auth)

26081 THERMAL SHIELDING IN THE NUCLEAR POWER PLANT. Karch, W. Waerme-Kaelte-Schall; 17: No. 2, 2.5–2.11(1973). (In German).

The mechanical construction of the KKN, supported by numerous diagrams, is described. The description of the constructive measures taken for thermal isolation is especially dealt with. (GE)

Power Reactors, Breeding

Refer also to abstracts 24646, 25953, 25970, 26006, 26067, 26069, 26139, 26184, 26283, 26312, and 26390.

26082 (AEC-tr-7488) IRRADIATION OF 80 AND 85 PERCENT FUELS IN RAPSODIE. Carteret, Y.; Conte, M.; Trotabas, M.; Kryger, B.; Lallement, R.; Ratier, J. L. (International Atomic Energy Agency, Vienna (Austria)). 1973. Translation of SM-173/10. (CONF-730726-18). 22p. Dep. NTIS $4.00.

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973).

Rapsodie was used to irradiate 162 fuel pins of 80 and 85% theoretical density from 38,000 to 82,000 MWd/t. These low density mixed oxide pins were clad in stainless steel-316 or Hastelloy X. The performance of the pins as determined from past irradiation examinations is described. (JWR)

26083 (AI-AEC-13116) CONDENSER VAPOR TRAP FOR SODIUM SERVICE. Guon, J. (Atomics International Div., Canoga Park, Calif. (USA)). 21 Jan 1974. Contract AT(04-3)-824. 82p. AT.

A vapor trap has been developed to remove sodium vapor from the argon cover gas in LMFBR or other sodium-containing systems. The unit, designated as a Controlled Temperature Profile (CTP) condenser vapor trap, is intended for high sodium burden, continuous gas flow operation. The cover gas, heated sufficiently to completely vaporize the sodium, is cooled at a controlled rate in a bed packed with $\frac{1}{4}$-in. Raschig rings, thus permitting diffusion of sodium to the surfaces of the rings with controlled liquid condensation and reflux. Starting with data available elsewhere on a CTP condenser rated at 0.07 scfm, performance data were obtained on two units rated at 0.8 and 5 scfm. These two experimental condensers were operated at sodium saturation temperatures over the range of 800 to 1050°F (500 to 10,500 wppm, respectively), and consistently reduced the exit sodium concentration to <1 wppm. A method to design CTP condensers for various applications is presented. Condensers designed for this method should have a flow capacity at least two times greater than the design value. For example, the 5 scfm unit operated satisfactorily at 15 scfm. (13 references) (auth)

26084 (AI-AEC-13119) FUELS, MATERIALS, AND CONTROL ROD DEVELOPMENT PROGRAMS. Quarterly Technical Progress Report, October–December 1973. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Feb 1974. Contract AT(04-3)-824. 36p. AT.

The studies include radiation effects on Type 316 stainless steel, helium generation in ^{10}B and ^{6}Li, and control rod heating experiments. (DCC)

26085 (AI-AEC-13120) SODIUM TECHNOLOGY AND COVER GAS SEAL DEVELOPMENT PROGRAMS. Quarterly Technical Progress Report, October–December 1973. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Feb 1974. Contract AT(04-3)-824. 113p. AT.

Development of cleaning and storage methods for liquid sodium coolant loop component is described. The friction test program for materials to be used in the FFTF cooling system is discussed. An evaluation of threaded fasteners for FFTF sodium systems is presented. The testing of cover gas seals for LMFBR and FFTF cooling systems is surveyed. (JWR)

26086 (AI-AEC-13121) LMFBR IN-VESSEL STORAGE REFUELING COMPONENT DEVELOPMENT PROGRAM. Quarterly Technical Progress Report, October–December 1973. Berg, G. E.; Bilibin, K.; Moody, E.; Jones, C. E. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Feb 1974. Contract AT(04-3)-824. 26p. AT.

Progress in the development and testing of handling devices for core components for an LMFBR is reported. The devices include an in-vessel transfer machine and an ex-vessel transfer machine. (DCC)

26087 (ANL-RDP-24) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, JANUARY 1974. (Argonne National Lab., Ill. (USA)). 27 Feb 1974. Contract W-31-109-eng-38. 160p. Dep. NTIS $7.60.

Progress in LMFBR development studies is reported under the following headings: EBR-2; hot fuel examination facility; LMFBR design support; instrumentation and control; fuels and materials development; reactor physics; reactor safety; and environmental studies. GCFR studies are also described. (DCC)

26088 (CEA-CONF-2450) FUEL MANAGEMENT AND ECONOMICS. Vendryes, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). [nd]. 5p. (CONF-721109-30). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on nuclear solutions to world energy problems; Washington, District of Columbia, USA (12 Nov 1972).

The low cost of the fuel cycle is the most attractive feature of the fast neutron breeder reactor. In order to achieve it a good fuel management is essential, with well balanced fixed investment and renewal fuel costs. In addition the designer can optimize the power station as a whole (fuel cycle and thermal characteristics). (auth)

26089 (CEA-CONF-2461) SAFETY ANALYSIS OF POWER REACTORS IN FRANCE: GENERAL PRINCIPLES AND PRACTICAL APPLICATIONS. Bourgeois, M. J. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France)). 1973. 14p. (In French). (CONF-730983-1). Dep. NTIS (U. S. Sales Only) $3.00.

From Congress of the Society of Electrical, Electronic and Radio Engineers meeting; Vittel, France (11 Sep 1973).

Before authorizing the construction or exploitation of nuclear installations, the French administration responsible for giving such authorization demands that a technical analysis of the envisaged safety equipment be carried out. The general principles used up until the present day for safety analysis of nuclear reactors are presented, examples of applications to sodium cooled fast neutron and pressurized water nuclear reactors being given. 4 references. (auth)

26090 (CONF-730726-12) FABRICATION BY BELGONUCLEAIRE OF PLUTONIUM FUEL RODS FOR THE SNR REACTOR. Leblanc, J. M. (Societe Belge de Chimie Nucleaire, Brussels). 1973. 17p. (SM-173-8-49). Dep. NTIS $3.00.

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973).

After having summarized the basic specifications of fuel rods for the first SNR core, this document briefly describes the fabrication process that will be used, sets out certain problems linked with the industrial operation of a plutonium fuel production unit, and comments on some fabrication stages of particular importance as regards obtaining the characteristics desired for the fuels. The facilities in which the fuel will be fabricated are briefly described. (auth)

26091 (CONF-730942-P3, pp vp Paper G 1/5) INELASTIC ANALYSIS IN LMFBR REACTOR VESSEL DESIGN. Wu, C. G. (Combustion Engineering, Inc., Chattanooga, TN). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

LMFBR reactor vessels are designed to withstand groups of severe thermal transients and operate at very high temperature for decades. The safe design of such nuclear components unavoidably requires knowledge of inelastic time-dependent and time-independent analysis. The criteria for inelastic design at elevated temperature are tentatively defined in ASME Code Cases 1331-5 through -7 of Section III. The limitations and definitions of different failure modes can also be found there. With the existing computational techniques it is demonstrated that a complete cyclic inelastic analysis can be obtained analytically for three-dimensional structures of a general nature. The results presented illustrate the up-to-date capabilities of inelastic analysis. This paper is intended to narrow the gap between the theoretical discussions and the practical applications of inelastic analysis. For this purpose, it is attempted to answer the questions such as: (1) how a reasonable inelastic analysis can be obtained by the finite element method; (2) how the information needed for the practical designs is reduced and interpreted from the massive computational results; (3) what difficulties and limitations are involved in the analysis and; (4) what precautions should be taken in advance. It is known that the accuracy of inelastic analysis is ultimately limited by three main factors; these are constitutive equations, material properties and loading history. Unlike the elastic analysis, the factors affecting an inelastic result may become multiple-dimensional as the structure becomes complex. For the purpose of illustration, three complete analyses for the components of a sodium reactor vessel are presented. The examples include the determination of the ultimate strength of a physically complex supporting structure and two cyclic elastic-plastic-creep analyses with prescribed loading histories. The materials presented may be helpful to designers and researchers at this state of the art to develop a reliable analytical method for inelastic analysis. It may be noted that the technology of inelastic analysis is still undergoing very rigorous development and refinement. (auth)

26092 (CONF-730942-P3, pp vp Paper G 1/6) SIMPLIFIED METHOD OF INELASTIC ANALYSIS FOR THE DESIGN OF SODIUM COOLED FAST REACTOR VESSELS. Pellissier-Tanon, A. (Societe d'Etudes Nucleaires et de Techniques Avancees, Courbevoie, France). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The analysis of the loadings supported by the structural elements of a sodium cooled FBR primary circuit shows that progressive deformation is a major risk of failure. To fill up the gap which appears between the numerical methods of inelastic analysis, which are accurate but costly, and simple code rules such as the rule 13 of the ASME code case 1331-5, which is very conservative, there is an urgent need for simplified methods of inelastic analysis, allowing to make sure that the accumulated deformations do not exceed some specified limit, although avoiding the explicit calculation to these deformations. The basis of such a method has been set forth for the design analysis of the vessels of reactors of the integrated type such as PHENIX. The calculation model is founded on the theory of thin shells, and assumes that the behavior of a shell element is elastic-perfectly-plastic under the rather fast loading conditions associated with the start up and shut down transient periods of the reactor, and that viscoplastic creep may occur during the operating periods. The analysis is performed in two stages: in the first one Melan's theorem is used to establish that shakedown occurs during the transient periods. In the second one, it must be checked that the point which represents the loading state of any shell element during the operating period, after shakedown, is located inside a boundary of limit loading for creep. To obtain that the accumulated deformation at each cycle remains smaller than a specified limit $\delta\epsilon$, the two conventional yield stresses of the model, σ_ϵ^p for instantaneous plasticity and σ_ϵ^f for the creep limit, are defined in the following way: In principle σ_ϵ^p is the stress which corresponds to $\delta\epsilon$ in a cyclic stress-strain relation appropriate to the transient loading conditions, and σ_ϵ^f is the stress which corresponds to $\delta\epsilon$ on an isochronous creep stress-strain relation which should take into account the previous cyclic hardening of the metal. In practice, lower values for σ_ϵ^p and σ_ϵ^f may be obtained from conventional test. In addition, it appears that the method imposes bounds to the cyclic deformation which are low enough to prevent failure by fatigue. The application of that method to the vessels of the reactor PHENIX has led to loading limits which are definitely higher than those which would have been imposed by the use of the rule 13 of the code case 1331-5. (auth)

26093 (CONF-730942-P3, pp vp Paper H 2/5) THREE-DIMENSIONAL RUPTURE ANALYSIS OF A PRESTRESSED CONCRETE PRESSURE VESSEL INCLUDING CREEP EFFECTS. Saugy, B.; Zimmermann, T.; Hussain Khan, M. (Ecole Polytechnique Federale, Lausanne, Switzerland). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Results obtained since September 1971 by the research work carried out in the field of non-linear analysis up to rupture of a PCRV taking into account creep effects are described. In the earlier work done in this field the influence of redistribution of stresses was restricted to short-time effects in the evaluation of rupture pressure of a PCRV. The research carried out since then aimed firstly to make a synthesis of constitutive laws describing the behavior of concrete under short-time or sustained loads and temperature gradients and of its rupture strength under tri-axial state of stresses which allowed to bring into evidence the principal parameters governing the behavior of concrete and to take them into account in the analysis. Secondly, it aimed to examine the influence of redistribution of stresses due to the rheological behavior of concrete on the rupture pressure of a PCRV. First the method of non-linear analysis for creep and rupture is described briefly. The mathematical model, of a general application, is based on the finite element method, utilizing the isoparametric elements, non-linearities are introduced by use of iterative techniques. It allows one to predict under satisfactory limit the behavior of massive prestressed concrete structures loaded up to destruction. The use of classical parameters for definition of the physical characteristics of materials for formulating the constitutive laws makes the model particularly interesting for practical applications. The analysis of the PCRV for a Gas-Cooled Fast Reactor developed by the Swiss Federal Institute for Reactor Research is presented. This PCRV has large cavities in its walls to house direct cycle gas turbines and other mechanical equipments. First the creep analysis is done taking account of the envisaged construction schedule and the loading conditions of internal pressure and thermal gradients created during the testing period and finally during the normal exploitation of the PCRV. Proceeding from the state of stress obtained as such the rupture analysis is carried out for a sudden increase of internal pressure and of temperature gradient due to an hypothetical accident. (auth)

26094 (EURFNR-1143) ADJUSTMENT OF GROUP CROSS SECTIONS FOR FAST REACTOR CALCULATIONS USING INTEGRAL DATA FROM CRITICAL ASSEMBLIES. Fischer, E. A. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). Oct 1973. 40p. (KFK-1878). Dep. NTIS (U. S. Sales Only) $4.00.

Worked performed under United States–Euratom Fast Reactor Exchange Program.

A series of integral measurements on fast critical assemblies was used to adjust group cross sections by a least-squares procedure. The initial cross sections were those of the well-documented Karlsruhe group constant set NAPPMB. The integral data were calculated by the same methods which are used in the routine analysis of critical experiments. Then, adjustments to these cross sections were obtained by a least-squares procedure, which minimizes the errors on the integral data, plus the errors on the cross sections. The procedure was carried out for two cases, using foil measurements, and fission chamber measurements of the fission ratio F8/F5. The results are discussed, and used to judge the consistency of integral measurements. 29 references. (auth)

26095 (EURFNR-1146) FAST REACTOR PROGRAM: THIRD QUARTER 1973. Progress Report, July 1–September 30, 1973. Hoekstra, E. K. (Stichting Reactor Centrum Nederland, Petten). Dec 1973. 68p. Dep. NTIS (U. S. Sales Only) $5.50.

Work performed under United States-Euratom Fast Reactor Exchange Program.

The STEK-500 core and its build-up are described; reactivity worths of isotopes and elements measured in the STEK cores 1000 and 4000 are presented; fission product cross section sets are intercompared. Results are given of the isothermal out-of-pile burst tests on tubes of material 1.4981 and of the post-irradiation examination of fuel pin R54-F26 which failed after an 80-minute in-pile burst test. Data obtained from thermodynamic measurements on UN and thermal expansion measurements on U(C,N) as well as an account of progress made with the preparation of UNF are reported. Cesium uranate phase investigations are discussed. Progress on determining the neutron radiation effect on the mechanical properties of austenitic steel 1.4948 is reported. Data on the decay of the particle number concentration of platinum oxide aerosols in condensing water vapor obtained under various aerosol formation conditions are compared. Bowing of pins in bundles and two-phase heat transfer experiments in sodium are discussed; results of heat transfer experiments in air performed on the roughened rods LUCY 106, 109 and 110 are compared with those obtained with other rods at an earlier date. 22 references. (auth)

26096 (GEAP-13951-1) LIFE-II FUEL PERFORMANCE CODE: EVALUATION OF PREDICTIONS OF CLADDING INELASTIC STRAIN. Stephen, J. D.; Murata, R. E.; Vaidyanathan, S.; Turner, J. E.; Meinhardt, W. G. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Aug 1973. Contract AT(04-3)-893. 49p. AT.

The LIFE-II Fuel Performance Code, Revision 3, has been evaluated for use in fuel rod design analysis for predicting fuel-to-cladding mechanical interaction. Extensive sensitivity studies of predicted cladding inelastic strain as a function of fabrication and operating parameters, thermal and mechanical performance models, and material properties were conducted and compared where possible with the review of the experimental data reported in GEAP-13985. In addition, the structural analysis procedure in LIFE-II was evaluated by comparing the stress and strain distribution predicted by LIFE-II with the predictions using another structural analysis code for the same boundary conditions. Recommendations for improving LIFE-II are made in the areas of nodal structure, structural analysis procedure, fuel models, cladding models, and coding. 10 references. (auth)

26097 (GEAP-13952) F20 EXPERIMENT DESIGN BASIS REPORT. McCarthy, W. H.; Cantley, D. A.; McWethy, L. M.; Black, T. J.; Wing, K. D. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Sep 1973. Contract AT(04-3)-893. 56p. AT.

The F20 experiment is a power-to-melt experiment to be irradiated in EBR-II at peak powers sufficient to produce fuel melting. The irradiation will consist of three phases (a restructuring phase, a high power phase to produce fuel melting, and a steady state phase below melting to investigate effects of continued operation after fuel melting). A total of twenty-nine fuel rods representing a range of burnups and design variables will be irradiated utilizing a Mark-A 19 subassembly. Passive instrumentation has been included in the subassembly as well as in certain fuel rods to enable accurate characterization of the irradiation environment during each of the three phases. The primary objective of the experiment is to provide accurate experimental data for design calculations on mixed-oxide fuel operating limits and fuel performance limits in support of near term FFTF and LMFBR needs. The F20 experiment will achieve this objective through a reduction in uncertainties associated with mixed-oxide fuel thermal conductivity, fuel restructuring, fuel-to-cladding gap conductance, and power-to-melt. 14 references. (auth)

26098 (GULF-GA-A-12824) GAS-COOLED FAST BREEDER REACTOR. Quarterly Progress Report for the Period August 1, 1973 Through October 31, 1973. (Gulf General Atomic Co., San Diego, Calif. (USA)). 10 Dec 1973. Contract AT(04-3)-167. 87p. Dep. NTIS $5.45.

The tasks of the Gas-Cooled Fast Breeder (GCFR) program are program planning, core development, out-of-pile heat-transfer and fluid-flow tests, development of a pressure-equalization system for fuel rods, fuels and materials development, and nuclear analysis and reactor physics. The core development task is to establish criteria for the design of the GCFR fuel, control, and blanket element assemblies. Analytical methods are being developed for predicting fuel-rod response to transient conditions and for treating thermal-hydraulic and structural analyses of fuel assemblies. For the heat-transfer and fluid-flow tests of fuel assemblies, planning of the test program and test facility was initiated. The development work on the pressure-equalization system included designing the test assemblies for static adhesion tests and seal leakage tests, development of the fuel-rod manifold, and development of an analytical model for designing monitoring instrumentation. In the fuels and materials task, the status of the thermal and fast-flux irradiation programs and analyses of data from these experiments are given. Nuclear analysis and reactor physics work included GCFR critical experiment planning, surveillance of LMFBR critical assembly experiments, and methods development. (auth)

26099 (HEDL-SA-658) MASS TRANSPORT OF RADIOACTIVE MATERIAL IN FLOWING SODIUM. Brehm, W. F.; Grandy, G. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1973. Contract AT(45-1)-2170. 41p. (CONF-740301-2). Dep. NTIS $4.25.

From NACE meeting-corrosion/74; Chicago, Illinois, USA (4 Mar 1974).

The corrosion and deposition of radioactive materials in flowing sodium, both in test loops and in operating sodium-cooled nuclear reactors are analyzed. The ultimate goal is the reduction and/or control of the movement of radioactive material from the reactor cores to the heat transport system piping. The reduction or control will minimize inplant maintenance costs and improve plant operating factors for the Fast Flux Test Reactor (FFTF) and subsequent Liquid Metal Fast Breeder Reactors (LMFBR). (18 references) (auth)

26100 (JAPFNR-133) ONE-DIMENSIONAL 70-GROUP P_1 CODE (PRODUCTION OF FAST REACTOR GROUP CONSTANTS (I)-3). Katsuragi, S.; Narita, H.; Suzuki, T.; Hasegawa, A. (Japan Atomic Energy Research Inst., Tokyo). Apr 1973. 25p. (JAERI-Memo-5237). Dep. NTIS (U. S. Sales Only) $3.25.

For Power Reactor and Nuclear Fuel Development Corp., Tokyo, Japan.

The EXPANDA series and the related fast reactor codes are not applicable to reactor systems containing very light element such as helium or hydrogen gas. For criticality calculation of these systems, a one-dimensional 70-group P_1 equation code has been developed as a modified version of FRAU-PO code (JAERI-memo 2623). The JAERI-fast set in 70 group structure has become usable. The new version FRAU-PO-70 is briefly described. 4 references. (auth)

26101 (JAPFNR-140) BASIC STUDIES ON VENTED FUEL. 1. Development of Vented Fuel. Hirose, Y.; Oguma, M.; Maru, A.; Miura, N. (Hitachi Ltd., Tokyo (Japan)). Mar 1972. 112p. (PNC-J-202-72-19). Dep. NTIS (U. S. Sales Only) $7.75.

In relation to operating behavior of check valve constructing the Plug-Bell vent mechanism, some material properties were investigated, namely as following items: melting point of low melting point alloy; thermal expansion of low melting point alloy; and pore sizes and permeability of porous plug materials. As for low melting point alloy, melting point tended to decrease and thermal expansion coefficient tended to increase with fuel burnup (viz. deposition of F. P.), however differences among values were within error range, and nearly 2% of volume change were measured before and after phase change at the order of 100,000 MWD/T. As for porous plug materials, maximum pore sizes were 4 ~ 20 times as large compared to the nominal sizes. 17 references. (auth)

26102 (ORNL-TM-4400) FAST REACTOR ANALYTICAL SHIELDING PROGRESS REPORT FOR MARCH AND APRIL 1973. 189a No. 10318, Activity No. 04 40 01 03 1. Abbott, L. S. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. Contract W-7405-eng-26. 25p. AT.

Analytical shielding work performed for the fast reactor program during the months of March and April 1973 consisted of several calculations supporting the design of various regions of the FFTF and the analyses of three Tower Shielding Facility experiments. The FFTF studies were for the branch-arm pipe shielding, the FTR radial cavity shield and head compartment, and the HTS pipeway and IHX vault. In addition, the calculation of the power of the stored-fuel modules, needed for accurate calculations of other FFTF regions, were repeated for a revised fuel-element composition. The three TSF experiments being analyzed were performed to study the penetration of neutrons in large thicknesses of sodium, the streaming of neutrons through a mockup of the FTR pipeway, and the production of secondary gamma rays in iron/polyethylene configurations. Of these, the analysis of the first experiment (the sodium-penetration experiment) was completed. (auth)

26103 (ORNL-TM-4401) FAST REACTOR ANALYTICAL SHIELDING PROGRESS REPORT FOR MAY AND JUNE 1973. 189a No. 10318, Activity No. 04 40 01 03 1. Abbott, L. S. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. 77p. AT.

Analytical shielding work performed for the fast reactor program during the months of May and June consisted of a continuation of the FFTF studies in progress during the March–April period, an analysis of the second phase of the TSF–FTR pipe-chase neutron-streaming experiment, two cross-section sensitivity studies, a continuation of the analysis of the TSF iron/polyethylene secondary gamma-ray experiment, and calculations supporting the use of thermoluminescent dosimeters for gamma-ray heating measurements. The FFTF studies included a general review of the branch-arm pipe shielding; calculations of the penetration of neutrons, secondary gamma rays, and sodium-activation gamma rays through the radial cavity shield and head compartment; design support calculations for the HTS pipeway and IHX vault, and calculations of the stored-fuel power. The first sensitivity study investigated the sensitivity of the calculated neutron tissue dose at the exit face of a large Na–Fe system to all the cross sections used in the calculations, and the second study investigated the sensitivity of the calculated neutron damage to the FTR grid plate to the nickel cross sections used in the calculations. (auth)

26104 (ORNL-TM-4514) FAST REACTOR EXPERIMENTAL SHIELDING PROGRESS REPORT, NOVEMBER–DECEMBER 1973. 189a No. 10028, Activity No. HN 04 01 01 1. Clifford, C. E.; Muckenthaler, F. J.; Stevens, P. N.; Freestone, R. M. Jr. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 37p. AT.

The program for a total cross-section experimental check was continued and NE-213 fast neutron spectra are reported for the bare beam, a sample of iron 19 in. thick, a 25-in.-thick graphite sample, a 12-in.-thick nickel sample, a 12-in.-thick stainless steel sample, and a 10-in.-thick chromium sample. Low-energy neutron spectra obtained with the hydrogen counter are reported for the 19-in.-thick iron sample and the 12-in.-thick stainless steel sample. Also reported is a brief description of a rod drop experiment conducted by the I & C Division of ORNL at the Tower Shielding Facility during the month of December. (auth)

26105 (ORNL-TM-4533) DEVELOPMENT OF AN AXIAL-FLOW CENTRIFUGAL GAS BUBBLE SEPARATOR FOR USE IN MSR XENON REMOVAL SYSTEM. Gabbard, C. H. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 39p. Dep. NTIS $4.00.

An axial-flow centrifugal type bubble separator was developed for application in the xenon removal system proposed for a molten-salt breeder reactor. The gas bubbles in this type separator would be driven toward the centerline by the radial pressure gradient developed in the liquid vortex. The gas would be collected in a void along the centerline and would be removed along with some entrained liquid through takeoff ports on both the upstream and downstream ends of the separator. The theory of operation as well as the design and development testing of a 500 gpm separator having a gas capacity of about 1.3 scfm at 1300°F, is described. The separation efficiency at design flow rates varied between 80% and 95% depending on the bubble diameter and test fluid. (auth)

26106 (WAPD-TM-1109) CALCULATION OF THE INTERACTION OF THE 23.45 eV and 21.78 eV RESONANCES OF ^{232}Th IN A ThO_2 ROD. LWBR Development Program. Buslik, A. J.; Kapo, P. S.; Gelbard, E. M. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Jan 1974. Contract AT-11-1-GEN-14. 11p. Dep. NTIS $3.00.

An analytical model for the interaction of the 23.45 eV and 21.78 eV resonances of ^{232}Th in a ThO_2 rod is given. Part of this interaction is caused by an actual cross-section overlap; the cross section at any energy is a superposition of the cross section due to each resonance separately. Another quite significant part of the interaction comes from the fact that the absorption in the 23.45 eV resonance of ^{232}Th sets up Placzek oscillations because of the oxygen moderation in the rod, and these oscillations decrease the absorption in the 21.78 eV resonance of ^{232}Th. The cross-section overlap effect is treated by Häggblom's theory. The Placzek oscillation effect is treated by a model in which the absorption in the 23.45 eV resonance is represented as a negative monoenergetic source; the flux due to this source is computed using Chernick's integral equations involving escape probabilities. A numerical comparison to a RESQ (Combined Monte Carlo and analytic calculation) is given for an LWBR rod. (13 references) (auth)

26107 (WARD-D-23) CLINCH RIVER BREEDER REACTOR PLANT NUCLEAR ISLAND. Progress Report for Quarter Ending September 30, 1973. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1973. 85p. AT.

Information on the Clinch River Breeder Reactor is presented concerning program management activities, reactor engineering research and development, and safety and licensing activities. (DCC)

26108 SODIUM GIVES NEW CHALLENGE TO COMPONENT MAKERS. Energy Int.; 11: No. 2, 21-23(Feb 1974).

Three European fast breeder reactor projects are based on the use of liquid sodium as a heat transfer medium. Construction of a commercial prototype is being planned in the USA. In France, the 250 MW(e) Phenix prototype at Marcoule is delivering power and an additional 1000 MW(e) unit is planned. At Dounreay, Scotland, the 275-MW(e) Prototype Fast Reactor (PFR) is in the commissioning test stage. In Germany, the 300 MW(e) SNR 300 prototype is being developed with Belgian and the Netherlands. These projects depend on liquid sodium as the primary coolant between the reactor and the turbine steam cycle. The design parameters necessary for the heat exchangers and the circulating pumps with the use of sodium are presented. (MCW)

26109 DEFINITIONS OF BREEDING RATIO AND DOUBLING TIME. Wyckoff, H. L. (Commonwealth Edison Co., Chicago); Greebler, P. Nucl. Technol.; 21: No. 3, 158-164(Mar 1974).

Breeding ratio (BR) and doubling time (DT) will become increasingly important indices as utilities and manufacturers seek to harness the breeder reactor. From these indices, it is possible to quickly sense the capability of a particular breeder reactor to produce more fuel than it uses. A set of definitions of BR and DT is proposed that appears well suited to overall fuel-cycle performance considerations. A key feature of these definitions is that BR is a value that is time averaged over one fuel cycle. A fuel cycle begins at the time of reactor startup after refueling and ends when the reactor is shut down for subsequent refueling. In addition, the determinations are based on all fuel in the core and blankets at the beginning and end of the fuel cycle, as contrasted to only those portions that are entering or leaving the reactor. Determining BR and DT in this manner gives results that are both accurate and consistent. 3 references. (auth)

26110 CIVIL DEFENSE IMPLICATIONS OF AN LMFBR IN A THERMONUCLEAR TARGET AREA. Chester, C. V.; Chester, R. O. (Oak Ridge National Lab., TN). Nucl. Technol.; 21: No. 3, 190-200(Mar 1974).

A pot-type Liquid-Metal-Cooled Fast Breeder Reactor was analyzed as a civil defense problem in a nuclear attack. In order for the core inventory of fission products to add significantly to casualties, they must be promptly released from the reactor structure due to blast from the weapon, and added to the fallout. The analysis of the interaction of weapon effects with the significant elements of the structure surrounding the reactors was checked by high explosive tests on scale models. It is concluded that for prompt ejection of the core, a megaton-range weapon must be detonated close enough so that the reactor is in the crater, or that an air shock greater than 170 atm impacts at near normal incidence the fueling cell wall crossing the sodium tank. For megaton weapons, delivery accuracy substantially exceeding that ascribed to deployed strategic delivery systems would be required. 16 references. (auth)

26111 CALIBRATION STABILITY OF OXYGEN METERS FOR LMFBR SODIUM SYSTEMS. McKee, J. M. (Argonne National Lab., IL); Vissers, D. R.; Nelson, P. A.; Grundy, B. R.; Berkey, E.; Taylor, G. R. Nucl. Technol.; 21: No. 3, 217-227 (Mar 1974).

Twenty commercially available oxygen meters using improved $ThO_2-Y_2O_3$ electrolytes were tested at two sites. Repeated calibration by the vanadium equilibration method showed the slope of the curve to be constant and identical for all meters. One vanadium equilibration per month was sufficient to correct for drift of the intercept. Ten meters (at one site) were used continuously for 18 months without failure. Two oxygen meters are now in routine use in EBR-II primary sodium. The observed stability and life of the present meters are considered adequate for effective use in LMFBR sodium systems. 13 references. (auth)

26112 HYDROGEN-ACTIVITY METER FOR LIQUID SODIUM AND ITS APPLICATION TO HYDROGEN SOLUBILITY MEASUREMENTS. Vissers, D. R.; Holmes, J. T.; Bartholme, L. G.; Nelson, P. A. (Argonne National Lab., IL). Nucl. Technol.; 21: No. 3, 235-244(Mar 1974).

A diffusion-type hydrogen-activity meter has been developed at Argonne National Laboratory to measure the hydrogen level of the sodium coolant in Liquid Metal Fast Breeder Reactor systems. The meter can be operated in two modes: an equilibrium mode and a dynamic mode. In the equilibrium mode, the hydrogen pressure in equilibrium with the sodium is measured by a pressure sensor and is related to the hydrogen concentration in the sodium by the Sieverts' law constant for the hydrogen-sodium system. In the dynamic mode, the hydrogen concentration in sodium is measured by the rate of hydrogen diffusion through a nickel membrane immersed in the sodium. A vacuum of 10^{-6} to 10^{-8} Torr is drawn on the membrane at a steady rate by an ion pump, and the hydrogen activity gradient from the sodium side to the vacuum side of the membrane causes hydrogen to diffuse through the membrane. The partial pressure of hydrogen on the vacuum side, a measure of the hydrogen flux and hydrogen activity in the sodium, is determined by measuring the current to the ion pump. The meter is unique in that it does not require any form of external calibration. 37 references. (auth)

26113 PHENIX PLANT: FAST NEUTRON PROTOTYPE PLANT. Tech. Mod.; 65: No. 10, 23-32(Oct 1973). (In French).

The general layout of the Phenix reactor is presented. The core, vessels, circuits, energy recovery equipment (sodium circuits, exchangers, and steam generators), turbo-alternator and condenser assembly, water supply circuit, auxiliary boiler, apparatus for handling the fuel assemblies, and the components of the reactor block and the installation controlling the reactor and the plant are briefly described. (FR)

26114 CIVIL ENGINEERING AND THE PHENIX POWER PLANT. Lacroix, R.; Magnas, J. P. (Societe Generale d'Entreprises, Paris). Tech. Mod.; 65: No. 10, 33-37(Oct 1973). (In French).

The principal characteristics of the construction work undertaken for the Phenix plant are linked to the time constraints imposed (the preliminary work was drawn up and options taken in a very short time duration), to the prototype nature of the plant, to the very difficult organizational problems occurring, and to the nuclear nature of the plant. Prefabricated constructions having different characteristics and leak tightness properties were used for the two principal buildings (reactor building and equipment handling building). The way in which leak tightness problems were overcome and the performance obtained are discussed. (FR)

26115 DEVICE PROVIDING A LEAKTIGHT SUPPORT FOR THE ROTATING PLUGS IN THE SLAB OF A NUCLEAR REACTOR. Jacquelin, R. (to Commissariat a l'Energie Atomique). French Patent 2,155,075. 6 Oct 1971. 10p. (In French).

A device is presented which provides a leaktight support for a rotating plug in the slab sealing a nuclear reactor vessel. This device is provided with supports, parts allowing the appropriate movement, and sealing joints (between the lower face of the plug collar and the corresponding part of the upper face of the slab). Part of the upper face of the slab is in the form of a ring raised up from the rest of the slab. The other parts and the collar are equipped with sealing joints, annular friction track parts and a means for raising the plug. Means are also available for centering during the rotation of the plug and for tightening up the collar onto the slab during the operation of the reactor. These plugs are used, in particular, for liquid metal cooled fast neutron reactors. (FR)

26116 LMFBR: STATE OF DEVELOPMENT AND ECONOMIC OUTLOOK. Taylor, J. J.; Hobson, R. G. Technical Meeting No. 7/2. Basel; Nuclex (1972). 27p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The status of the liquid metal fast breeder reactor development in the Unites States is reviewed by examining the progress in design and construction of the Fast Flux Test Facility and the breeder demonstration power plant, by reviewing overall progress in the supporting technological development, particularly in fuel and sodium technology, by examining the status of development and testing of steam generator concepts, and finally, in examining the progress achieved to date in meeting the economic goals for breeder power plant performance. (auth)

26117 SMELTING AND REPROCESSING OF STEELS FOR TUBING OF FAST SODIUM-COOLED BREEDER REACTORS. Hauck, H.; Becker, H.; Kleibeler, H. Technical Meeting No. 7/10. Basel; Nuclex (1972). 23p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The influence of remelting on the manufacture of tubing for nuclear fuel elements according to specification for a sodium-cooled fast breeder using the steels 4988, 4981 and $^{15}/_{15}$ CrNiTiB is analyzed. It has shown that remelting in the vacuum consumable-electrode furnace and remelting by the electro-slag process are equivalent. 8 references. (auth)

26118 DEVELOPMENT OF SOME STUDY AND FABRICATION TECHNIQUES FOR SODIUM FAST REACTOR CORE VESSELS. Payan, G.; Milan, D.; Savornin, B. (Technical Meeting No. 7/11. Basel; Nuclex (1972). 9p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The present stage of certain advanced mechanical studies which were undertaken during execution of Phenix core-vessels is described together with their scope of development: strength of materials, with a due account of creep problems; flow-induced random vibrations; and electron-beam welding of large austenitic steel sheets. 6 references. (auth)

26119 FAST NEUTRON POWER PLANT PROTOTYPE: PHENIX. Megy, J.; Guillemard, B.; Robert, E.; Crette, J. P.; Labat, P. Technical Meeting No. 7/1. Basel; Nuclex (1972). 22p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Main features of PHENIX, i.e., power, integrated design, fuel and fuel handling cycles are summarized. The main difficulties and solutions which were selected in the field of design, main component tests and manufacturing are described. (auth)

26120 SOME ASPECTS OF THE UK PROTOTYPE FAST REACTOR PROJECT. Cartwright, H. Technical Meeting No. 7/3. Basel; Nuclex (1972). 21p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Attention is drawn to the provisions for operating the PFR in support of the development of commercial fast reactors. The close relationship of the various parts of the British fast reactor project is described. (auth)

26121 GAS-COOLED FAST REACTOR DEVELOPMENTS AS SEEN FROM THE USA. Melese-D'Hospital, G.; Meyer, L. Technical Meeting No. 7/4. Basel; Nuclex (1972). 30p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The GCFR concept under development in the U. S. is a near-term high gain breeder using stainless steel clad UO_2-PuO_2 fuel rods cooled by pressurized helium. The whole primary circuit, i.e., core, blanket and thermal shields, circulators and heat exchangers, is contained in a multicavity PCRV like those for large HTGRs, with a leaktight secondary containment. The only really different features between GCFR and LMFBR fuel elements, namely artificial surface roughening and pressure equalization across the cladding, are now under test in- and out-of-pile both in Europe and in the U. S. Detailed design and safety studies of a 300 MW(e) GCFR demonstration plant have revealed no major feasibility problems, and it is believed that, with adequate funding for R & D and construction, the plant could be in operation in the early 1980s. Parametric studies of commercial size GCFRs indicate very favorable performance and economics as compared to LMFBRs. The potential exists for further improvement, with higher coolant temperature, direct cycle, carbide fuels, and for an attractive symbiosis with HTGR fueled by U-233 coming from thorium blankets in the GCFR. 28 references. (auth)

26122 EVOLUTION AND IMPROVEMENT OF THE PERFORMANCES OF FRENCH SODIUM APPARATUS. Raczynski, W.; Le Frere, J. P.; Refoubelet, P.; Cazes, M. Technical Meeting No. 7/7. Basel; Nuclex (1972). 15p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The equipment which is necessary for the operation of the sodium installations has reached an industrial point and has stood the test of experience. The common characteristic is to be able to work continuously in a sodium temperature of 600°C, this value being the present temperature level for the installations built for the development of fast reactors cooled with sodium. Two kinds of equipment are examined: the electromagnetic pumps and the measuring apparatus. (auth)

26123 REACTOR TOP SHIELD FOR THE SNR (SODIUM-COOLED FAST BREEDER REACTOR). Leder, H.; Kirchner, G.; Rauschert, G.; Rothfuss, H. Technical Meeting No. 7/8. Basel, Nuclex (1972). 9p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The top shield of the vessel for the sodium-cooled fast breeder reactor SNR-300 is designed as a rotating-plug system. The system comprises 3 rotating-plugs arranged eccentrically inside one another. Gas-tightness is achieved by means of two inflatable seals whose interspace is slightly pressurized by a purge gas. The rotating plugs are supported by a wire-ball bearing. Seals and bearing can be exchanged without difficulty. (auth)

26124 REVIEW OF AVAILABLE FAST REACTOR FUELLING METHODS AND A PROPOSAL FOR A REFUELLING SCHEME FOR LARGE COMMERCIAL FAST REACTORS. Lawson, D. S.; Peberdy, J. M.; Wolff, P. H. W. Technical Meeting No. 7/9. Basel; Nuclex (1972). 15p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The refuelling of pool type sodium reactors is described. Fuel handling schemes and equipment are discussed. 7 references. (auth)

26125 SELECTION OF GAS COOLED FAST BREEDER REACTOR CHARACTERISTICS. Chermanne, J. Technical Meeting No. 7/12. Basel; Nuclex (1972). 21p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The selection of the different characteristics of a GCFR is discussed in detail for two types of fuel elements: pins and coated particles. The resulting designs are shown. (auth)

26126 EVOLUTION OF THE DESIGN OF STEAM GENERATORS AND INTERMEDIATE HEAT EXCHANGERS BETWEEN THE PHENIX POWER PLANT AND THE DESIGN OF THE 1200 MW(e) POWER PLANT. Robin, M.; Perrin, R.; Pouderoux, P.; Tillequin, J. Technical Meeting No. 7/13. Basel; Nuclex (1972). 28p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

26127 ELECTRO-MAGNETIC LIQUID METAL PUMPS AND THEIR APPLICATION TO A CIVIL FAST REACTOR. Orszak, P. Technical Meeting No. 7/14. Basel; Nuclex (1972). 14p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Experience now obtained with the design and operation of the four basic types of e.m. pump is described. The development of the output capability of the e.m. pump to the sizes required for main coolant circulation in commercial fast reactors appears to be worthy of serious consideration on the grounds of potential advantages in reactor availability. 5 references. (auth)

26128 SOME ASPECTS OF SODIUM PUMPS DESIGNED FOR FUTURE FAST NEUTRON REACTORS. Raczynski, W.; Cazes, M.; Refoubelet, P. Technical Meeting No. 7/15. Basel; Nuclex (1972). 22p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The next stage of breeder reactor development will be the design and specification of a commercial power plant. As regards to the components of this power plant, a change will be noted. In some cases, this change will result in a large increase in size as compared with the present state. Some problems encountered during preliminary studies on sodium pumps are described. (auth)

26129 PROBLEMS POSED BY THE STUDY AND DEVELOPMENT OF LOADING PLUGS FOR SODIUM-COOLED FAST NEUTRON REACTORS. Lagrange, M.; Chevallier, R.; Perona, M. Technical Meeting No. 7/16. Basel; Nuclex (1972). 13p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Designing and manufacturing a loading plug (or rotating shield plug) for the Phenix Reactor present various problems relating to a wide number of fields. After consideration of the functions of the Phenix loading plug, an analysis is made of the most important options taken during the design period. The loading plug is then described with its principle data. The main features of the manufacture of these parts, both in the shops and on site are recalled. (auth)

26130 FROM HIGH-TEMPERATURE GAS-COOLED REACTORS TO GAS-COOLED FAST BREEDER REACTORS. Simon, R. H.; Schlueter, G. J. (Gulf General Atomic Co., San Diego, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst.; PAS-92: No. 4, 1195-1200(1973).

The evolution of gas-cooled reactors is described and the advantages of helium as a reactor coolant stemming from its inertness and the fact that it is a single-phase coolant are discussed. The High-Temperature Gas-Cooled Reactor (HTGR) forms the basis for the current design of a Gas-Cooled Fast Breeder Reactor (GCFR). The extensive use of existing HTGR technology and the similarities between GCFR fuel requirements and those of the Liquid Metal Fast Breeder Reactor (LMFBR) are emphasized. Basing the development on these other technologies minimizes the effort required for the GCFR. (auth)

26131 NUCLEAR INSTALLATION FOR SOFTENING WATER IN THE USSR. Kolytchev, B. Energ. Nucl. (Paris); 15: No. 3, 188-189(May 1973). (In French).

The fast neutron Soviet reactor BN-350 (1000 MW(t)) will enable a daily output of 120,000 m^3 of fresh water to be obtained. The reactor was designed to supply the town Shevtchenko on the east coast of the Caspian sea. The data obtained on the reactor are described together with the now complete test runs and the fresh water production installation currently being installed in successive stages. (FR)

26132 STATUS AND SAFETY ASPECTS OF THE 300 MW(e) GCFR DEMONSTRATION PLANT. Milioti, S. J. (American Electric Power Service Corp., New York); Larrimore, J. A. Nucl. Eng. Des.; 26: No. 1, 187-194(1974).

The Gulf General Atomic concept of the gas-cooled fast breeder reactor (GCFR) utilizes development that has already taken place on the high temperature gas-cooled reactor (HTGR), principally in plant systems and components, and it will benefit directly from the development work carried out to support the LMFBR—primarily the nuclear fuel development. Recent progress in the development work and engineering design for the 300 MW(e) GCFR demonstration plant is highlighted and the safety aspects of this plant are discussed. 18 references. (auth)

26133 RESPONSE OF GAS-COOLED FAST BREEDER REACTORS TO DEPRESSURIZATION ACCIDENTS. Buttemer, D. R.; Larrimore, J. A. (Gulf General Atomic Co., San Diego, CA). Nucl. Eng. Des.; 26: No. 1, 195-200(1974).

The gas-cooled fast breeder reactor (GCFR) under design by Gulf General Atomic is cooled with helium pressurized to 85 atm and has the reactor core, the steam generators and their associated steam turbine-driven helium circulators, and auxiliary core cooling loops all contained within a massive prestressed concrete reactor vessel (PCRV). The response of the GCFR to coolant depressurization accidents has been investigated and it has been shown that this class of accidents can be safely handled with considerable safety margin. Rapid depressurization is assumed to be caused by a seal failure in a large concrete plug closing one of the large PCRV cavities and the depressurization rate is controlled by a flow restrictor incorporated within the closure plug. Continued core cooling is provided by the main core cooling loops. The plant transient response following a depressurization accident has been calculated with a computer code developed at GGA. The results obtained indicate rather mild increases in peak clad temperature for a depressurization accident with the leak area defined by the flow restrictor. Additional cases investigating larger leak areas to explore safety margins indicate that the peak cladding temperature does not increase rapidly with increasing leak area. Secondary containment conditions in a depressurization accident have also been evaluated. 4 references. (auth)

26134 IRRADIATION TESTING OF DESIGN MODELS FOR THE GCFR FUEL PRESSURE EQUALIZATION (VENT) SYSTEM. Campana, R. J.; Lindgren, J. R. (Gulf General Atomic Co., San Diego, CA). Nucl. Eng. Des.; 26: No. 1, 201-214(1974).

The major consideration in the design of the pressure equalization system for the gas-cooled fast breeder reactor is the release and venting of gaseous and volatile fission products. Single vented rods have been irradiated in the thermal flux of the Oak Ridge Research Reactor (ORR) at GCFR operating conditions of 12 to 15 kW/ft and 565 to 685°C cladding outside temperature to determine the fission product release and to verify the design concept. Results obtained to date from measurements of fission gas release and transport have been compared with predictions based on design assumptions to verify analytical models and have established a degree of conservatism of design assumptions. The release of radioactive gases from the fuel matrix was measured directly at 12 kW/ft in an operating fuel rod and was found to be significantly less than the design assumption of 100% instantaneous release and less than predictions using the diffusion model with Findlay's coefficients. Although solid state diffusion was found to be the dominant process delaying the venting of fission gases in the experimental irradiation, fission gas interdiffusion in helium will be the dominant venting transport process for the reactor design. Delay of fission gases by adsorption on charcoal was verified at trap operating temperatures for burnups up to 54,000 MWd/t. Volatile fission products (cesium and iodine) did not migrate beyond the fuel–blanket interface. The feasibility of the vented-fuel-rod design concept has been established. 16 references. (auth)

Research, Test, and Experimental Reactors

Refer also to abstracts 25577, 25970, 26002, 26049, 26083, 26085, 26087, 26094, 26097, 26099, 26102, 26103, 26116, and 26198.

26135 (AAEC/TM-618) EXAMINATION OF THE FAILURE OF A TEN-INCH ALUMINIUM LINER IN THE REACTOR HIFAR. Jostsons, A.; Hanna, G. L.; Blake, R. G.; Meller, E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jan 1973. 33p. Dep. NTIS (U. S. Sales Only) $3.75.

After ten years of operation in the AEC's reactor HIFAR to a fluence of 3×10^{21} n cm^{-2} (E > 1 MeV) in the range 300–470°C, the ten-inch diameter horizontal aluminium liner was found to be distorted, blistered and fractured. Metallurgical investigations indicate that growth of gas bubbles containing He and H_2 from (n,α) and (n,p) reactions of fast neutrons with Al is the major cause of deterioration. Less detailed studies of reactor components operating in contact with heavy water at ~50°C indicate that the effect of radiation damage within the reactor tank is unlikely to be a limiting factor in the life of the reactor HIFAR. 7 references. (auth)

26136 (AEC-tr-7490) MECHANICAL PROPERTIES OF RAPSODIE CLADS AND HEXAGONAL WRAPPERS. Steel Swelling in Rapsodie Hexagonal Wrappers. Dupouy, J. M.; Erler, J.; Allegraud, G.; Bisson, A.; Blanchard, P.; Vouillon, M.; Sagot, J. P.; Weisz, M. (International Atomic Energy Agency, Vienna (Austria)). 1973. Translation of SM-173/15. (CONF-730726-20). 20p. Dep. NTIS $4.00.

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973).

The irradiation effects on work hardened stainless steel-316 in Rapsodie hexagonal wrappers and hyperquenched stainless steel-316 in Rapsodie clad sections were studied. The irradiation creep and swelling results are discussed. (JWR)

26137 (ANCR-1134) FISSION FRAGMENT DRIVEN (d + t) NEUTRON IRRADIATION SOURCE FOR CTR MATERIALS DAMAGE IRRADIATIONS. Miller, L. G.; Young, R. C.; Brugger, R. M. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Jan 1974. Contract AT(10-1)-1375. 16p. Dep. NTIS $3.00.

A 14 MeV neutron irradiation facility, based on thermal neutrons producing fission fragments which initiate the $d + t \rightarrow n + {}^4He$ reaction, is evaluated. Calculations are made to determine the expected yield. It is concluded that the facility is feasible, that it would produce 3.5 times more flux than a similar facility in which the thermal neutrons produce tritons when absorbed by ${}^6Li$, and that fluxes near 10^{12} 14 MeV n/cm^2sec would be produced using the best flux-trap reactors now available. This flux level is high enough to make major contributions to CTR materials damage studies. (auth)

26138 (CEA-N-1644) DOSIMETRY OF RADIOINDUCED DAMAGE. Cance, M.; Cantet, S.; Genthon, J. P.; Kremser, J.; Micaud, G.; Salon, L.; Villain, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)). Aug 1973. 40p. (In French and English). Dep. NTIS (U. S. Sales Only) $4.00.

The GAMIN technique is used to measure flux damage in Rapsodie. The principles and applications of this technique are described in an appendix; some typical results obtained with various types of reactor are given. This technique allows the flux damage induced in a graphite detector to be measured. It also enables the activities induced in a Ni detector to be established, thus permitting the index of the graphite/nickel spectrum to be determined directly. The parameters are measured at various different positions around the core-reflector boundary of Rapsodie for different environments. It is found that although these parameters are relatively insensitive to the environment, they vary very rapidly along a radius of the reactor in this zone (about 40% for 33 mm). These measurements are applied to determining the fluences received by steels and graphites. The high dose irradiations effected with Rapsodie can be analyzed in this way and compared to those effected with OSIRIS using the same method. (FR)

26139 (CONF-731015-6) UTILIZATION OF THE RESULTS OF ZPPR-2 CRITICAL EXPERIMENTS IN LMFBR NUCLEAR DESIGN. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1973. Contract AT(11-1)-3045. 3p. Dep. NTIS $3.00.

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973).

Results of analyses are presented for determining the uncertainty in the extrapolation from the plate configuration of the fuel in ZPPR to the pin geometry of the fuel in the actual LMFBR. (auth)

26140 (HEDL-SA-430) NEUTRON DOSIMETRY FOR FAST REACTOR EXPERIMENT. Ulseth, J. A.; Combs, B. L.; Jackson, J. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1973. Contract AT(45-1)-2170. 50p. (CONF-731101-53). Dep. NTIS $4.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

Multiple dosimeter foils are used by the Fast Reactor Materials Dosimetry Center (FRMDC) to characterize the neutron environment for fast reactor irradiation experiments in EBR-II and other test reactors. Techniques, equipment, and procedures for handling, encapsulation and logging of dosimeter foils, and hot cell recovery are described. The SAND-II computer code is used to derive necessary flux-spectral information from the measured foil reaction rates. Examples of "as-built" dosimetry and typical SAND-II derived flux-spectral data provided to experimenters are used to illustrate the multiple foil dosimetry system that has been developed by the Fast Reactor Materials Dosimetry Center (FRMDC) at Hanford Engineering Development Laboratory. (11 references) (auth)

26141 (JUL-977-RE) MEASUREMENT OF THE FISSION PRODUCT ACTIVITY FOR FAILED FUEL ELEMENT DETECTION AS A CONTRIBUTION TO REACTOR SAFETY OF THE FRJ-2. Rehm, W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralabteilung Forschungsreaktoren). Jul 1973. 97p. (In German). Dep. NTIS (U. S. Sales Only) $7.00.

Methods to measure fission product activities for the detection of failed fuel elements are described. The failed fuel elements can be detected and localized by a fuel element scanning system by measuring the fission product activities in the primary coolant. The methods of neutron measurement, gamma spectroscopy and the precipitation method are described. As an example, activity measurements are reported which have been carried out in the FRJ-2 (DIDO) in a special reactor experiment (loop test No. 20) according to the precipitation method in order to be able to monitor the fuel elements of the FRJ-2 by means of a selective fission product detection in the coolant. From the results measured in this reactor experiment, optimum operating parameters have been determined for a burst can detection system of the FRJ-2. This system has been designed to indicate fuel element failures in the FRJ-2 by means of the precipitation method. 12 references. (GE)

26142 (JUL-988-RX) FLUX DENSITY MEASUREMENTS IN THE FRJ-2 REACTOR USING DIRECT READING DETECTORS IN CONNECTION WITH A PROCESS COMPUTER AND A SHIELDING BOTTLE. Bachner, E.; Bertram, W.; Koenig, P.; Otzen, G.; Schmidt, K.; Schneider, W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Reaktorexperimente). Aug 1973. 44p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

After a comparative evaluation of activation probes and direct reading detectors for neutron flux density measurements, the measuring device used at the FRJ-2 reactor for direct reading and activation measurements is described. First, the mechanical construction and the instrumentation are illustrated. Then the measuring device command and data processing by the process computer SIEMENS 301 are explained. Finally, the method of operation is described and experiences gained in practice are reported. 9 references. (GE)

26143 (WARD-5095) FLOW TRANSIENTS IN CLIRA AND TSMDA. Agrawal, A. K.; Hoppner, G.; Coffield, R. D.; Bradbury, P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Advanced Reactors Div.). [nd]. 6p. (CONF-731101-51). Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

The capability of the Closed Loop In-Reactor Assembly (CLIRA) in FFTF to accommodate various postulated events is demonstrated. These events include, in their order of severity, (a) flow coastdown, (b) inlet pipe break, and (c) inlet blockage. All of these accidents are extremely unlikely, nonetheless the consequences of even the most severe flow-transient accident is shown to cause no failure propagation to the reactor, even if a Test Section Meltdown Accident (TSMDA) should result. (auth)

26144 (WARD-NA-3045-7) SODIUM TECHNOLOGY PROGRAM. Progress Report for Period Ending October 31, 1973. Ray, W. E. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Jan 1974. Contract AT(11-1)-3045. 91p. AT.

Progress is reported on the following FFTF subtasks: friction and wear testing, self-welding evaluation, duct load materials evaluation, and interstitial transfer. The materials studied included: Inconel 718, A286, Types 304 and 316 stainless steels, Stellite 6 and 156, coatings for FTR duct load pads, and 2¼ Cr–1 Mo. (DLC)

26145 FLOW COAST DOWN AND THE CORRESPONDING SCRAM DELAYS AFTER SIMULATED FAILURE OF PUMP POWER SUPPLY IN EWA RESEARCH REACTOR. Strupczewski, A.; Budzinski, W.; Kicman, J. (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 18: No. 11, 525-534(1973).

Flow coast down and the corresponding scram delays in EWA research reactor were studied after simulated failure of power supply to one, two and three pumps in the primary circuit. The measurements were performed at reactor shut-down and aimed at establishing the real curve of flow coast down as well as the apparent curves of flow and pressure transients measured by EWA stationary equipment. Scram delays for studied cases were recorded. The case of the outage of one high voltage line with an automatic pump power supply switch over to another line was also studied. (auth)

26146 UTILIZATION OF ON-LINE MONITORS AT EBR-II FOR SODIUM PURITY. Holmes, J. T.; Haroldsen, G. O. (Argonne National Lab., IL). Nucl. Technol.; 21: No. 3, 228-234(Mar 1974).

The Experimental Breeder Reactor-II (EBR-II) primary sodium system is equipped with continuous monitors for oxygen and hydrogen impurities in the sodium. The sensors of these monitors have been incorporated into a modularized system that was developed for nuclear reactor applications for sodium temperature and sodium flow-rate conditioning. The oxygen meter calibration is provided by periodic analysis of the oxygen in sodium by the vanadium-equilibration method. The hydrogen meter is a direct reading device and does not require on-line calibration. Typically, the impurity content of the sodium has been shown to be quite stable at 0.6- to 1.0-ppm oxygen and 0.06- to 0.08-ppm hydrogen. On-line carbon monitors are not presently in use at EBR-II. A single determination of the chemical activity carbon in sodium gave a result of 0.002 relative to graphite and is about the same value as measured in other "clean" stainless steel-sodium systems. Plans are being made to equip the EBR-II secondary system with ten hydrogen meters that will be used for detecting the onset of steam-to-sodium leaks such that corrective action can be taken before the leak enlarges and propagates to adjacent tubes. 13 references. (auth)

26147 INVESTIGATION BY THRESHOLD DETECTORS OF THE FAST NEUTRON SPECTRA IN CRITICAL ASSEMBLIES. Lomakin, S. S.; Morozov, A. G.; Petrov, V. I.; Popov, S. G.; Samoilov, P. S.; Fofanov, V. S. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 17, 23-31(1972). (In Russian).

A method is described for the measurement of the fast neutron spectra of critical assemblies by use of a set of threshold detectors (Rh, In, Ni, Zn, Fe, Al, and Mg). The fast neutron spectrum in the center of the assembly was calculated by the iteration method. (tr-auth)

26148 MODELING AND IDENTIFICATION OF NUCLEAR POWER REACTOR DYNAMICS FROM MULTIVARIABLE EXPERIMENTS. Olsson, G. (Lund Inst. of Tech., Sweden). pp 375-384 of Identification and Systems Parameter Estimation. I. Eykhoff, P. (ed.). Amsterdam; North-Holland Publishing Co. (1973).

From third identification and systems parameter estimation symposium; The Hague/Delft, Netherlands (12 Jun 1973). See CONF-730676–P1.

The purpose of this work is to find linear stochastic point models of low order of the Halden Boiling Water Reactor (HBWR). The models should be used for control of core pressure and nuclear power. Another goal is to test different identification methods on a large system like a nuclear reactor. The plant is a multivariable system and three inputs are considered essential, viz. a consumers steam valve, a subcooling flow valve, and reactivity from control rods. The models are assumed linear, where some parameters depend on the operating level. A number of identification experiments have been performed on the HBWR in cooperation with the OECD Halden Reactor Project in Norway. After a series of single input experiments several multivariable runs have been performed. In the latter case two or three inputs were used independently in pseudo random binary sequences, while the nuclear power and pressure controls were removed. (auth)

26149 MEASUREMENT OF THE GAMMA FIELD IN NUCLEAR PHYSICS INSTALLATIONS. Gadzhiev, G. I.; Mukhachev, B. V.; Neverov, V. A.; Rudakova, G. M.; Samoilov, P. S.; Shanin, A. A. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 17, 49-55(1972). (In Russian).

Results were reported of the measurement of the intensity of the exposure dose P of γ radiation in channels of the BOR reactor and physical models of the MIR reactor obtained with small ionization chambers and type SI-34G. γ counter measurement systems. A description and basic characteristics of the measurement system are given. The distribution of P_γ along layers of the biological shield and the dependence of P_γ on the height in the experimental and thermocouple channels during startup of the BOR reactor were reported. The measurement results in the experimental channels at reactor power of 40 MW and neutron flux density of 5×10^{13} neutrons/cm^{2}sec showed that the basic contribution to the energy release is given by fast and intermediate neutrons and the γ radiation contribution (0.1%) can be neglected. (tr-auth)

26150 USE OF THE F-1 REACTOR AS A STANDARD THERMAL NEUTRON FIELD FOR CALIBRATION OF NEUTRON DETECTORS. Garapov, E. F.; Inikhov, A. G.; Lomakin, S. S.; Mukhachev, B. V.; Panfilov, G. G.; Petrov, V. I.; Samoilov, P. S.; Khmyzov, V. V. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 20, 11-14(1973). (In Russian).

The parameters of the thermal neutron field in the graphite F-1 reactor are reported. The reactor can be used as a high-intensity standard thermal neutron source during the calibration of neutron detectors of various dimensions. An example is given of the use of this source for the calibration of a current ionization chamber in the region of neutron flux density from 10^7 to 10^{10} neutrons/cm^2 sec with an error of ±5%. (tr-auth)

26151 DRAGON REACTOR OPERATING EXPERIENCE. Chapman, B. G. Technical Meeting No. 3/2. Basel; Nuclex (1972). 23p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Although the primary purpose of the Dragon Reactor is to irradiate experimental HTR fuels, these activities generate a great deal of useful experience in operational areas such as helium utilization, the design and maintenance of helium components and circuits, and the behavior of radioactive species. This experience over the last six years is reviewed. It is frequently difficult to predict the operational performance of large plants from the drawing board and the chief value of experience is to establish the practical limits which can be achieved. In this respect Dragon has demonstrated the viability of the HTR concept and has enabled realistic design criteria to be laid down. 10 references. (auth)

26152 EVOLUTION OF FUEL ELEMENTS FOR RESEARCH AND IRRADIATION REACTORS. Serole, B. Technical Meeting No. 5/15. Basel; Nuclex (1972). 15p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

For more than ten years, CERCA has been supplying fuel elements for research and irradiation reactors. The pauseless increasing performances of the reactors have asked improvements of all the steps of the fuel elements manufacture. Therefore CERCA found original processes in the fields of powder metallurgy for the cores and the burnable poison, of cladding by rolling, of assembly and of control. (auth)

26153 HIGH-TEMPERATURE CRITICAL EXPERIMENTS WITH H_2O-MODERATED FUEL ASSEMBLIES IN KRITZ. Persson, R.; Blomsjoe, E.; Edinius, M. Technical Meeting No. 2/11. Basel; Nuclex (1972). 14p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The pressurized critical facility KRITZ is operated up to a maximum temperature of 245°C. Buckling measurements on single-rod lattices of slightly enriched UO_2 (1.35 wt % $^{235}UO_2$) are reported. Two lattices with different moderator-to-fuel volume ratios (1.44 and 2.11) were studied. Experiments on Pu-bearing fuel (1.5% Pu, 0.16% ^{235}U) are in progress. (auth)

Production and Materials Testing and Processing Reactors

Refer also to abstracts 24672, 26076, and 26180.

26154 (UNI-39) EVALUATION OF WEATHERED IMPREGNATED CHARCOALS FOR RETENTION OF IODINE AND METHYL IODIDE. Bennett, E. C.; Strege, D. E. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 31 Jul 1973. Contract AT(45-1)-1857. 33p. Dep. NTIS $3.75.

Impregnated charcoal samples in B cell in the N Reactor confinement system were exposed to weathering by constant air flow from the Zone-I ventilation system. In D cell, the same charcoals were aged. After six months, samples were tested for their efficiency in trapping I_2 and CH_3I. The retention efficiencies for I_2, the current accepted bases for N Reactor halogen filter media acceptability, showed little change from that of unexposed charcoal. However, the CH_3I retention was severely degraded in all cases, with no conclusive differences between B and D cell samples. Analyses showed extraneous organic material on the samples, which may have adversely affected the ability of the charcoals to adsorb CH_3I. The B cell samples contained varying concentrations of organic material up to 28 mg/g of charcoal. The CH_3I retention was less than 25% for all charcoal types. Samples taken from B cell after 12 and 18 months exposure and evaluated showed a continuing degradation, with the 18-month samples showing less than 6% retention efficiency. The organic pollutants in these samples remained at about the 28 mg/g level previously observed, indicating a sharply reduced rate of pollutant accumulation on the filter media. Fresh samples charged in A cell in October 1972 showed a small continuing accumulation of oil, at a rate of 2.5 mg/g charcoal for the three-month period. Samples discharged with 3-month and 6-month exposures showed CH_3I retention efficiencies in the 40 to 70% range, with a decreasing trend with exposure. The observed retention efficiencies are comparable to results reported by other investigators for the severe test conditions employed (80°C and 100% relative humidity). However, results of these tests continue to indicate a limited life for CH_3I retention with the accumulation of organic pollutants a potential factor. (9 tables, 12 figures) (DLC)

26155 FISSION CHAMBER STARTUP CHANNEL (26 APR 1964) (ENGINEERING MATERIALS). (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). (CAPE-2390).

11 drawings.

Drawings of the fission chamber startup channel for a Savannah River Plant reactor are presented. (DCC)

26156 NUCLEAR ENERGY AND THE DEMINERALIZATION OF WATER IN THE FEDERAL REPUBLIC OF GERMANY. Budde, E. (Bundesministerium fuer Forschung und Technologie, Bonn). Energ. Nucl. (Paris); 15: No. 3, 186-187(May 1973). (In French).

A critical estimate of the possibilities for operating seawater desalination plants heated by means of nuclear energy in particular in the developing countries prompted the Federal Republic of Germany to re-examine the economics of relatively small nuclear reactors in connection with seawater desalination plants. The results are encouraging. It appears that freshwater prices amounting to between DM 1 and DM 2/m^3 can be achieved. If advanced underground irrigation systems are used, a Miniplex nuclear water station can make it possible for agricultural products to be cultivated in arid areas under competitive conditions. (FR)

26157 UNITED KINGDOM APPROACH TO DESALINATION AND NUCLEAR POWER-DUAL PURPOSE OPERATION. Pugh, O. (United Kingdom Atomic Energy Authority, London). Energ. Nucl. (Paris); 15: No. 3, 178-180(May 1973).

Nuclear desalination studies involving the utilization of heat from nuclear plants (normally using the multistage flash distillation process) are discussed. A considerable difference exists between the real cost of water obtained in this way and the cost envisaged in the optimized situation. Various nuclear desalination opportunities in the United Kingdom are compared with conventional water sources. The cost of desalted water varies with the primary energy cost. The development and operation of less costly nuclear desalination processes will help to stabilize desalted water costs, thus facilitating their integration into practical situations. (FR)

26158 NUCLEAR DESALINATION IN ISRAEL. Adar, J. (Israel Atomic Energy Commission, Tel Aviv). Energ. Nucl. (Paris); 15: No. 3, 181-185(May 1973). (In French).

Israel is particularly suited for the erection and operation of large nuclear dual-purpose plants for the production of both electric power and desalted sea water, the main reasons for this being: the lack of water and lack of natural energy resources, the existence of interconnected water and electricity grids with high system load factors, the existence of an underground storage capacity, experience in desalination techniques, etc. The main problems are the small size of the power system and the costs of desalted water. A review is made of the main nuclear plant studies carried out in Israel for the production of electricity alone as well as for the combined production of water and power. Two new desalination processes developed in Israel and suitable as nuclear heat sources are presented. (FR)

Propulsion and Package Reactors

Refer also to abstracts 24599 and 24709.

26159 (APEX-907) XMA-1 NUCLEAR TURBOJET. Comprehensive Technical Report, General Electric Direct-Air-Cycle Aircraft Nuclear Propulsion Program. Bifano, N. J.; Blumberg, B.; Hussey, C. C.; Tallman, R. E. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 15 Jun 1962. Contract AT(11-1)-171. 268p. Dep. NTIS $15.50.

Declassified 12 Sep 1973.

Information on the XMA-1 nuclear turbojet engine is presented concerning power plant specifications, biological shielding, turbomachinery, controls, test support equipment, and remote handling equipment. (DCC)

26160 (APEX-908(Pt. C)) XNJ140E NUCLEAR TURBOJET. Comprehensive Technical Report, General Electric Direct-Air-Cycle Aircraft Nuclear Propulsion Program. Layman, D. C. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 25 May 1962. Contract AT(11-1)-171. 362p. Dep. NTIS $20.25.

Declassified 12 Sep 1973.

Information on the XNJ140E nuclear turbojet engine is presented concerning biological shields, turbomachinery, and control system. (DCC)

26161 (CNLM-5511) 300 Kwe SNAP-50/SPUR POWERPLANT CHARACTERISTICS SUMMARY. Perry, P. I. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 24 Apr 1964. Contract AT(30-1)-2789. 25p. Dep. NTIS $3.25.

Declassified 30 Aug 1973.

26162 (GEMP-226) 710 REACTOR PROGRAM QUARTERLY REPORT NO. 4. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 31 Jul 1963. Contract AT(40-1)-2847. 52p. Dep. NTIS $4.75.

Declassified 21 Sep 1973.

Research progress in the 710 reactor program during the period included continued development of refractory-metal fuel elements, critical experiments, control and stability analysis, and preparation of a test program. (JWR)

26163 (PWAC-259) ADVANCED NUCLEAR RAMJET SUPERSONIC BOMBER POWERPLANT CHARACTERISTICS SUMMARY. Larson, J. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 15 Oct 1958. Contract AT(11-1)-229. 41p. Dep. NTIS $4.25.

Declassified 20 Sep 1973.

The results of a performance analysis of an advanced nuclear ramjet powerplant for a supersonic bomber are presented. The powerplant uses a 350 MW lithium cooled reactor coupled to ramjet engines. The weights, geometries, and performance characteristics of the system are described. (JWR)

26164 (PWAC-275(Suppl.1)) ADVANCED NUCLEAR TURBOJET POWERPLANT CHARACTERISTICS SUMMARY FOR SUPERSONIC AIRCRAFT. Larson, J. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 27 May 1959. Contract AT(11-1)-229. 22p. Dep. NTIS $3.25.

Declassified 12 Sep 1973.

The performance characteristics of a low compression nuclear turbojet engine equipped with interburners and afterburners are presented. Performance characteristics of a nuclear conversion of the Pratt and Whitney J-58 turbojet engine are also presented. (14 figures) (JWR)

26165 (PWAC-280) LOW POWER NUCLEAR ROCKET POWERPLANTS FOR INTERPLANETARY MISSIONS. Muller, G. L. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 8 Sep 1959. 40p. Dep. NTIS $4.00.

Declassified 20 Sep 1973.

A study of low-power, nuclear-hydrogen-rocket powerplants for application to the propulsion of interplanetary vehicles is presented. Minimum-weight, unshielded powerplants utilizing graphite-structure, hydrogen-cooled, intermediate-spectrum reactors and tungsten-structure, hydrogen-cooled, fast-spectrum reactors were analytically designed. A comparison of the graphite reactor powerplants and the tungsten reactor powerplants showed that tungsten powerplants weighed about half as much as graphite powerplants for the cases studied. However, the core reflectors have not been optimized, and, upon a more extensive analysis, the relative advantage of the tungsten reactor powerplant may change somewhat. The payload capacities of these nuclear powerplants and a fluorine-hydrogen chemical system for accelerating a vehicle from a geocentric orbit into a minimum-energy Earth-Mars transfer orbit are compared. It was found that tungsten-reactor-powered vehicles had larger payloads than the graphite-reactor-powered vehicles, and for vehicle gross weights greater than 6,000 pounds, they had larger payloads than the chemically-powered vehicle. The graphite-reactor-powered vehicles showed advantages over chemically-powered vehicles for gross weights above 12,000 pounds. (auth)

26166 (PWAC-337) DESIGN FABRICATION AND TEST OF A 1500°F NaK-NaK HEAT EXCHANGER. Randall, D. G.; Dloss, F. D. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 30 Jun 1961. Contract AT(11-1)-229. 82p. Dep. NTIS $6.25.

Declassified 20 Sep 1973.

HE-12CL is a completely welded, tube and shell, unbaffled unit fabricated at CANEL from Type 316 stainless steel. It was operated using NaK (56 percent Na) on both tube and shell sides, with countercurrent flow, at liquid metal temperatures to 1500°F, flow rates to 657 gpm and pressures to 150 psig, for a total time of 1140 hours. Three hundred and thirty hours of heat-up, purification, and performance testing were followed by 774 hours of endurance testing. The first structural failure, leakage between tube and shell sides, was detected after 560 hours of operation, of which 230 hours were at the endurance condition; 580 additional hours of operation, including 544 hours at the endurance condition, increased the internal leakage rate and ultimately caused a failure from shell side to atmosphere, necessitating test termination. The following observations can be drawn from the test: (1) The primary cause of failure was excessive creep of the heat exchanger structure at the hot (1500°F) end of the unit. (2) A secondary cause of failure may have been tube vibration near the hot end tube sheet. (3) No serious corrosion effects were observed. (4) Tube side mass transfer deposits were found on some tubes to ten mils thick. (5) Using the Lubarsky-Kaufman correlation, $Nu = 0.625\ P_e^{0.4}$ (Ref 1) to predict the overall tube side heat transfer coefficient, the over-all shell side heat transfer correlation can be expressed by $Nu = 0.037\ P_e^{0.8}$. (6) The tube-side pressure drop was slightly lower than predicted values; the shell side pressure drop was approximatley 40 percent lower than predicted. (7) The test rig, previously untried, was satisfactory in both reliability and performance with only minor exceptions. (auth)

26167 (PWAC-398(Pt.2)) LCRE ENGINEERING DEVELOPMENT REPORT. Doak, R. A. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 28 Feb 1964. Contract AT(11-1)-2789. 28p. Dep. NTIS $3.50.

Declassified 4 Sep 1973.

Progress is reported concerning core pressure vessel tests, fuel development, component development, compatibility and corrosion testing, and inert gas purification and analysis and liquid metal handling. (JWR)

26168 (TIM-866) PWAR-20 SHIELD PRELIMINARY ANALYSIS. (Pratt and Whitney Aircraft, Middletown, Conn. (USA). Connecticut Advanced Nuclear Engineering Lab.). 1 Dec 1964. Contract AT(30-1)-2789. 70p. Dep. NTIS $5.50.

Declassified 31 Aug 1973.

The preliminary physics and engineering design analyses of the shield for the SNAP-50/SPUR powerplant are described. (41 figures) (JWR)

26169 (UCRL-6258) PLUTO QUARTERLY REPORT NO. 6, OCTOBER–DECEMBER 1960. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Jan 1961. Contract W-7405-eng-48. 162p. Dep. NTIS $10.25.

Declassified 26 Nov 1973.

Information is presented concerning Tory-2A neutronics, aerothermodynamics, controls, and engineering; BeO–UO_2 fabrication and mechanical properties; and Tory-2C neutronics, aerothermodynamics, controls, and engineering. (DCC)

26170 (UCRL-7036(Pt.1)) TORY II-C PROGRAM: INTRODUCTION AND GENERAL DESCRIPTION. Goldberg, E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 21 Aug 1962. 9p. Dep. NTIS $3.00.

Declassified 26 Nov 1973.

26171 FEASIBILITY OF ROTATING FLUIDIZED BED REACTOR FOR ROCKET PROPULSION. Ludewig, H.; Manning, A. J.; Raseman, C. J. (Brookhaven National Lab., Upton, NY). J. Spacecraft Rockets; 11: No. 2, 65-71(Feb 1974).

The rotating fluidized bed reactor concept is outlined and its application to rocket propulsion discussed. Experimental results obtained indicate that minimum fluidization correlations commonly in use for 1-g beds can also be applied to multiple-g beds. It was found that for a low thrust system [90,000N (20,000 lbf)] the fuel particle size and/or particle stress play a limiting role on performance. The superiority of ^{233}U as a fuel for this type of rocket engine is clearly demonstrated in the analysis. The maximum thrust/weight ratio for a 90,000N thrust engine was found to be approximately 65N/kg. (19 references) (auth)

26172 CHOICE OF MATERIALS FOR THERMIONIC TRANSMITTERS. Delmas, R. (Centre d'Etudes Nucleaires, Grenoble, France). Rev. Gen. Elec.; 82: No. 9, 547-551(Sep 1973). (In French).

From meeting on nuclear thermionic generators; Marseilles, France (26 Oct 1972).

The desired characteristics of fuel elements are defined and problems associated with the transmitter examined. Uranium carbide and oxide are the most promising of fuels. Their relative advantages and disadvantages are reviewed. The interesting prospects of uranium–molybdenum oxide (cermet), a compound currently being investigated, are indicated. (FR)

26173 UNDERWATER APPLICATION OF THERMIONIC REACTORS. Clemot, M.; Devin, B. (CEN de Saclay, Gif-sur-Yvette, France). Rev. Gen. Elec.; 82: No. 9, 556-562(Sep 1973). (In French).

From meeting on nuclear thermionic generators; Marseilles, France (26 Oct 1972).

Current trends in off-shore exploration and exploitation involve increasingly large distances from the shore, deeper and deeper water, and inhospitable environments. Independently operating reliable energy sources are required. Thermionic reactors are very promising for such applications. It is envisaged that sufficient progress will have been made by the end of the decade to render their use feasible. From the economics point of view, it is necessary to consider the complete system in which the energy source is integrated and not simply the substitution of a reactor for another source. (FR)

26174 INCORE THERMIONIC REACTOR SYSTEMS FOR SPACE APPLICATIONS. Pruschek, R. Ind. At. Spatiales; 17: No. 4, 36-56(Jul 1973). (In French).

From international symposium on nuclear power and propulsion devices in space; Vienna, Austria (Jul 1973).

The principal layout characteristics of fast and moderated incore thermionic reactors with and without driver fuel elements are discussed. Potential performance data for thermionic reactor space power systems based on results obtained from development programs during the past decade are summarized. (FR)

Reactor Safety and Environmental Aspects

Refer also to abstracts 24188, 24216, 24217, 24519, 25984, 25985, 25987, 26017, 26018, 26028, 26072, 26089, 26110, 26133, 26143, 26145, 26308, and 26315.

26175 (AEC-tr-7521) SURVEILLANCE OF THE ENVIRONMENT OF NUCLEAR POWER STATIONS: THE HOUR OF REALISM. Pellerin, P. (USAEC Technical Information Center, Oak Ridge, Tenn.). 1973. Translation of SM-180/76. (CONF-731117-3). 20p. Dep. NTIS $3.00.

From symposium on environmental surveillance around nuclear installation; Warsaw, Poland (5 Nov 1973).

Radiation hazards to human populations from present and proposed nuclear power plants are discussed and compared with the radiation hazards of current medical practices in x-ray diagnosis and with the health hazards involved in the release of chemical and radioactive effluents from fossil-fueled power plants. It is contended that the development of nuclear power plants will be an enormous benefit for all mankind in that it will make available energy to raise the level of hygiene throughout the world and it will put an end to energy production by highly polluting processes. Further it is concluded that if standards for protecting the public from radiation hazards are kept at realistic levels, if operators of nuclear power plants are made responsible for nuclear safety within the plants, and if public health officials are independently responsible for monitoring all releases from nuclear power plants and for determining that radiation protection standards are met, then, nuclear power plants will prove their potential for improving worldwide public health. (LCL)

26176 (BARC-722) GUIDE BOOK FOR STACK PARAMETERS IN NUCLEAR AND ANCILLIARY CHEMICAL INSTALLATIONS. Shirvaikar, V. V. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 32p. Dep. NTIS (U. S. Sales Only) $3.75.

A guidebook on stack height and other parameters for nuclear and ancilliary chemical plants compiled for the use of designers of such plants is presented. The criteria to be used for determination of these parameters are discussed. These include (1) Aerodynamic criteria-effect of stack downwash, downwash due to presence of bluff bodies e.g., buildings and terrain. (2) Environmental safety criteria-influence of the permissible concentrations on the stack height, aspects of internal dilution etc. An appendix gives the approach to be followed for determination of stack height from meteorological data. (auth)

26177 (BNL-18223) AVERAGE EFFLUENT RELEASES FROM U. S. NUCLEAR POWER REACTORS, COMPARED WITH THOSE FROM FOSSIL-FUELED PLANTS, IN TERMS OF CURRENTLY APPLICABLE ENVIRONMENTAL STANDARDS. Hull, A. P. (Brookhaven National Lab., Upton, N. Y. (USA)). 19 Sep 1973. 15p. (CONF-730907-18). Dep. NTIS $3.00.

From 3rd international congress of the International Radiation Protection Association meeting; Washington, District of Columbia, USA (9 Sep 1973).

Between 1967 and 1972, eighteen "second generation" light-water-cooled nuclear power plants, with capacities in the range of 500 to 800 MW(e) have been put into operation in the United States. These were in addition to ten smaller demonstration plants and one high-temperature gas-cooled nuclear power plant in operation at the start of this period. The reported yearly air effluent releases of radioactive gases, halogens and particulates, and liquid effluent fission and activation products and of tritium from these plants are evaluated on a Ci/10^3 MW(e) basis, and the overall yearly averages for the various types of reactors [boiling water (BWR), pressurized water (PWR) and high temperature gas-cooled (HTGR)] are compared. These and the amounts of effluents released from reference 1,000 MW(e) fossil-fueled plants are compared in terms of relative environmental concentrations and their relationship to the applicable U. S. environmental standards for the principal constituents in their respective plant air-effluent streams. 21 references. (auth)

26178 (CEA-CONF-2477) RELIABILITY IN A SAFETY ANALYSIS METHOD. Carnino, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Surete Nucleaire). [nd]. 16p. (In French). (CONF-730714-3). Dep. NTIS (U. S. Sales Only) $3.00.

From generic techniques in systems reliability assessment conference; Liverpool, UK (16 Jul 1973).

The benefit of failure analysis and fault tree is very important to quantify the safety problems. The logical and deep analysis of the possible accidents, the knowledge of components under normal operation with their failure capabilities, the determination of major contributions to system unreliability, and the assessment of the overall failure of a system involved in a safety action are various tools now essential to safety analysts. A very important part in the safety analysis should be given to the influence of the test and maintenance programme and to the human reliability either in direct operation or in implementing the maintenance programme. 6 references. (auth)

26179 (FIND-50438) FIND: BELLEFONTE NUCLEAR PLANT, UNITS 1 AND 2. Items 1–24. Horn, F. H. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Mar 1974. 23p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc. and refer to grid coordinates on microfiche sheets prepared for each docket report. (JWR)

26180 (FRNC-TH-433) STUDY OF THE RELIABILITY OF NUCLEAR REACTOR SAFETY SYSTEMS. Alsan, S. (Grenoble-1 Univ., 38 (France)). 1972. 86p. (In French). Dep. NTIS (U. S. Sales Only) $6.50.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

A theoretical mathematical study of reliability is presented and the concepts subsequently defined are applied to the study of nuclear reactor safety systems. The theory is applied to investigations of the operational reliability of the Siloe reactor from the point of view of rod drop. A statistical study conducted between 1964 and 1971 demonstrated that most rod drop incidents arose from circumstances associated with experimental equipment (new set-ups). The reliability of the most suitable safety system for some recently developed experimental equipment is discussed. Calculations indicate that if all experimental equipment were equipped with these new systems, only 1.75 rod drop accidents would be expected to occur per year on average. It is suggested that all experimental equipment should be equipped with these new safety systems and tested every 21 days. The reliability of the new safety system currently being studied for the Siloe reactor was also investigated. The following results were obtained: definite failures must be detected immediately as a result of the disturbances produced; the repair time must not exceed a few hours; the equipment must be tested every week. Under such conditions, the rate of accidental rod drops is about 0.013 on average per year. The level of nondefinite failures is less than 10^{-6} per hour and the level of nonprotection 1 hour per year. (FR)

26181 (GULF-GA-B-12823) ASSESSMENT OF NOISE ANALYSIS TECHNIQUES FOR LARGE HTGRs. Borgonovi, G. M. (Gulf General Atomic Co., San Diego, Calif. (USA)). Nov 1973. Contract AT(04-3)-167. 44p. Dep. NTIS $4.00.

The results of a study carried out to assess the feasibility and convenience of applying noise techniques to HTGRs are presented. Noise analysis techniques seem to have some potential in monitoring power plants, from the point of view of safety. At the same time, as a result of technical developments during the last five years, the implementation of these techniques has become more economical. Instruments for the frequency analysis of time signals are now reasonably priced and commercially available. Several classifications of noise analysis into three categories are described. With regard to technique, the three categories are pulse counting methods, input reactivity variations, and measurements of the power spectral density. With regard to reactor state, these categories are the subcritical, zero power, and power condition. Finally, with regard to objective, the categories are the measurement of reactor parameters, the determination of the transfer function, and the detection of potential instabilities or malfunctions. A discussion on how the power spectral density technique can be relevant to HTGR safety is presented. The analysis of some potential signals shows that the use of self-powered detectors should permit the meaningful detection of small noise levels which are concentrated in a narrow frequency band. The performance of digital methods in obtaining estimates of power spectral densities, and the capabilities of commercial instrumentation are also discussed. The main conclusion is that a potential usefulness for noise analysis exists for the HTGR, as it exists for light water reactors. (auth)

26182 (IRS-W-7) DESIGN OF NUCLEAR PLANTS AGAINST EXTERNAL EFFECTS. Subject: Aircraft Impact. Intermediate Report. Drittler, K.; Gruner, P.; Suetterlin, L. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). Dec 1973. 22p. (In German). Dep. NTIS (U. S. Sales Only) $3.25.

Load assumptions are presented which, according to present knowledge, should be the basis for designing nuclear power plants against the consequences which might arise from aircraft impact on reactor buildings. The local effects of impact and the effects on the construction as a whole are analyzed. Penetration formulae are offered which allow for the calculation of the minimum thickness of the protective walls. A load-time-function for the impact of aircraft on rigid walls is also presented. 15 references. (auth)

26183 (NP-19736) WATER PROTECTION IN CONNECTION WITH COOLANT UPTAKE AND DISCHARGE IN CONVENTIONAL AND NUCLEAR POWER PLANTS. (Eidgenoessisches Dept. des Innern, Bern (Switzerland)). 19 Mar 1968. 116p. (In German). Dep. NTIS (U. S. Sales Only) $8.00.

A Commission was created by the Minister of the Interior to determine the effects of the use of water for coolant purposes by conventional and nuclear power plants. In its report the parameters to be considered in the evaluation of the problem are discussed. The effects of artificial heating of surface and underground water are outlined. The limnological effects on fresh water and salt water, effects on fish and fishing, and the modification of the temperature of ground water are considered. (JSR)

26184 (ORNL-TM-4417) LMFBR SAFETY AND CORE SYSTEMS PROGRAMS PROGRESS REPORT, JULY–SEPTEMBER 1973. Fontana, M. H. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. Contract W-7405-eng-26. 85p. AT.

The operation of the FFM facility is described. Experiments in the FFM water mockup are discussed. Improvements in analysis and data evaluation of FFM experiments are surveyed. The development of heaters for fuel pin simulation is described. (JWR)

26185 (SLA-73-841) ESTIMATE OF METEORITIC GENERATION OF TSUNAMI WAVES, WITH EXPLOSION EFFECTS ANALYSIS OF THE TUNGUSKA METEORITE. Reed, J. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1974. Contract AT(29-1)-789. 18p. Dep. NTIS $3.00.

Meteorite impacts on the ocean could be expected to cause explosions which, if large enough, could create tsunami-like waves resulting in disastrous effects on coastal areas. Available data on impact frequencies, wave generation by near-surface explosions, and wave amplification in shallow water have been used to estimate the hazard frequency. Results show that large waves from such meteoritic sources would occur about as often as comparable sea-level changes from cyclic ice-age glaciation changes. (auth)

26186 DEVELOPMENT OF NUCLEAR ENERGY AND ENVIRONMENTAL SAFEGUARD IN THE ITALIAN LICENSING SYSTEM. Ilari, O.; Polvani, C. Technical Meeting No. 9/14. Basel; Nuclex (1972). 10p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Italian nuclear laws were issued between 1960 and 1964. Their qualifying points concerning the environment are illustrated. An improvement for the environmental safeguard would be obtained passing from an administrative veto on the site proposal to the administrative indication of the areas for energy plants, in a planning policy of the national territory. (auth)

26187 INJURIES IN NUCLEAR POWER PLANTS. Feldmann, J. Technical Meeting No. 9/12. Basel; Nuclex (1972). 13p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

26188 INDUSTRIAL INSTALLATION FOR EMBEDDING RADIOACTIVE WASTES IN BITUMEN. Schwob, Y.; Le Blaye, G. Technical Meeting No. 9/10. Basel; Nuclex (1972). 10p. (In French).

From International nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Saint Gobain Techniques Nouvelles introduce the industrial facilities that they can offer at the present time for the conditioning of radioactive wastes produced by power reactors. Two solutions are offered: coating in a thin film evaporator or in a screw extrudor. Safety problems are studied in great detail. (auth)

26189 DEVELOPMENTS IN THE PROCESSING OF RADIOACTIVE WASTES FROM NUCLEAR POWER PLANTS. Rajakovics, G.; Gabernig, H.; Klein, G.; Jakusch, H.; Hofstaetter, K.

Technical Meeting No. 9/8. Basel; Nuclex (1972). 13p. (In German).
From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

26190 EXPERIMENTAL SEISMIC EVALUATION OF NUCLEAR POWER STATIONS. Ibanez, P.; Spencer, R. B.; Smith, C. B. Technical Meeting No. 9/3. Basel; Nuclex (1972). 11p.
From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).
Vibration testing of nuclear power plants and equipment is used to identify dynamic parameters. These parameters define models which are used to calculate the response of these structures to earthquakes. 10 references. (auth)

26191 DESIGN AND PRODUCT IMPROVEMENT FOR NUCLEAR POWER PLANTS WITH A VIEW TO ENVIRONMENTAL PROTECTION. Beattie, J. R. Technical Meeting No. 9/1. Basel; Nuclex (1972). 16p.
From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).
Radiation and radioactive effluents from nuclear power plants can be and are controlled so that no harm will be caused to the environment or the people who live there, and in this respect any desired reduction of radioactivity can be achieved, though at a cost. But some risk, however small, to people and their environment may arise from the possibility of a release of radioactive material caused by an accident in the plant. Improvements in safety are continually being made to the established thermal reactor types. A step in technology is about to be taken with the gradual introduction of fast reactors. As reactor types become more advanced, it is important that concurrent steps should be taken to ensure that there are corresponding improvements in reliability and safety. Nuclear reactors are but one class of power plants, which in turn form part of the general industrial system in which we live, and in which most plants have some potential for spoiling the environment. It would be to the disadvantage of this industrialized society, if the development and use of nuclear power were unduly restricted by needlessly high environmental standards, while insufficient attention were given to protecting the environment against possible effects from the other parts of the industrial system. (auth)

26192 NUCLEAR SAFETY. The Public Debate. Lapp, R. E. New Sci.; 61: No. 885, 394-396(14 Feb 1974).
The adequacy of the ECCS (Emergency Core Cooling Systems) has been challenged in protracted AEC hearings. Representatives of nuclear industry maintained that reactor safety is assured by large margins of safety built into the basic design of the reactor and was buttressed by conservative and redundant emergency safety systems. Anti-nuclear spokesmen asserted that the margins of safety were very narrow and that safety systems were unproved. Now AEC has announced a new study which will not be published for some months but it has been disclosed that it has been stated "on the basis of current reactor design, technical experts have estimated that the likelihood of an 'unlikely' accident with serious consequences to the public is of the order of one in a million reactor years". Some of the arguments put by scientists and laymen both for and against the future proliferation of nuclear plants are given. It is concluded that the nuclear hearings so far held have not resolved the safety issue but that airing of the controversy was salutary. (UK)

Reactor Theory and Calculation

Refer also to abstracts 25467, 25577, 25860, 26094, and 26100.

26193 (AAEC/LIB/Bib-405) HYDRODYNAMIC STABILITY IN BOILING CHANNEL FLOW. A Bibliography, 1954 to 1972. Geue, P. J. (comp.). (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sep 1973. 71p. Dep. NTIS (U. S. Sales Only) $5.75.
Two hundred ninety-two references are arranged chronologically and alphabetically by author within each year. An abstract to a citation is given for each reference. The citations include 21 bibliographies. (AT)

26194 (DOCKET-50285-176) FORT CALHOUN STATION, UNIT 1. Semiannual Report, August 5, 1973–December 31, 1973. (Omaha Public Power District, Nebr. (USA)). 26 Feb 1974. 106p. Dep. NTIS $7.50.
The initial operating period of the station including initial criticality on August 5, low power physics testing, and power ascension with commercial operation on September 26 is described. Information is also presented on shutdowns, maintenance, changes, tests, experiments, radioactive gaseous and liquid releases, radioactive solid wastes, environmental monitoring, and occupational personnel radiation exposures. (FS)

26195 (EUR-5048) ISOTEX: COMPUTER CODE FOR CALCULATION OF ISOTOPES CONCENTRATIONS AND RATIOS OF CONCENTRATIONS. Sola, A. (Commission of the European Communities, Luxembourg; Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). Feb 1974. 113p. (In French). Dep. NTIS (U. S. Sales Only) $7.75.
The code ISOTEX allows the calculation of concentrations and of ratios of concentrations of isotopes produced in a uranium and (or) plutonium reactor. The analytical solution of the differential equations describing the isotope transmutation schemes gives the value of the concentrations. The transmutation schemes, the heavy isotopes fission yields, the decay constants and the differential equations are presented. 17 references. (auth)

26196 (LA-5486-MS) STANDARD INTERFACE FILES AND PROCEDURES FOR REACTOR PHYSICS CODES, VERSION III. Carmichael, B. M. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 66p. Dep NTIS $5.45.
Standards and procedures for promoting the exchange of reactor physics codes are updated to Version-III status. Standards covering program structure, interface files, file handling subroutines, and card input format are included. The implementation status of the standards in codes and the extension of the standards to new code areas are summarized. (15 references) (auth)

26197 OPTIMAL XENON SHUTDOWNS FOR BORON CONTROLLED REACTORS. Salo, S. (Univ. of Helsinki). Acta Polytech. Scand., Phys. Nucl. Ser.; No. 90, 1-24(1972).
A new class of optimal xenon shutdown problems is introduced. Pontryagin's optimum theory is applied to the problem of determining a flux shutdown program that limits xenon poisoning with minimum cost in a reactor, where the amount of excess reactivity depends on the amount of boron present in the core of the reactor. Solutions are found for both the problem of minimum time and the problem of minimum flux time. Both solutions appear to be similar to those in rod controlled reactors. (auth)

26198 REAL-TIME NUCLEAR POWER PLANT PARAMETER IDENTIFICATION WITH A PROCESS COMPUTER. Roggenbauer, H. (OECD Halden Reactor Project, Norway). pp 403-406 of Identification and Systems Parameter Estimation. I. Eykhoff, P. (ed.). Amsterdam; North-Holland Publishing Co. (1973).
From third identification and system parameter estimation symposium; The Hague/Delft, Netherlands (12 Jun 1973). See CONF-730676–P1.
A dynamic least squares on-line identification algorithm is implemented on a process computer and applied to a simulated process and real process data. The pressure dynamics and the core dynamics of the Halden Boiling Water Reactor are studied with the help of this algorithm. Filtering techniques to be applied to the input data to the identifier are investigated. (auth)

26199 FEW-GROUP METHODS FOR FAST-REACTOR TRANSIENTS. Terney, W. B.; Svrivenkatesan, R. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Nucl. Sci. Eng.; 53: No. 3, 337-347(Mar 1974).
The suitability of flux- and bilinearly weighted collapsing schemes for fast-reactor transient analyses was studied. Comparisons of few-group transient results were made with "exact" 26-group and three-trial-function energy synthesis results. Normal flux weighting was not satisfactory even when up to 12 groups were used. Bilinear schemes with only 6 or 8 groups, using unperturbed fluxes and perturbed adjoints (or vice versa), were found to be satisfactory. When reactivities were less than one dollar, unperturbed fluxes and adjoints were sufficient to give satisfactory results. With bilinear group collapsing, it is necessary to consider discontinuities arising at interfaces between regions where the flux and adjoint spectra are different and to use modified continuity conditions. (auth)

26200 VOPROSY MATEMATICHESKOI TEORII REAKTOROV. Lineinyi Analiz. (Questions on the Mathematical Theory of Reactors. Linear Analysis). Shihov, S. B. Moscow; Atomizdat (1973). 376p.
A qualitative spectral analysis of the linear operators arising in critical and non-stationary problems of neutron transfer in a multiplying and non-multiplying inhomogeneous medium of finite volume is given. The solution of the critical and non-stationary problem is examined in Banach space functions summable according to energy, angular, and space coordinates by use of methods

of the theory of positive linear operators in Banah space with cones. (tr-auth)

Reactor Components and Accessories

Refer also to abstracts 24273, 24368, 24596, 24598, 24646, 24705, 24736, 24810, 24829, and 24841.

26201 (AEC-tr-7525) SPECIAL CHARACTERISTICS OF ION EXCHANGERS FOR NUCLEAR TECHNOLOGY. Kuehne, G. (USAEC Technical Information Center, Oak Ridge, Tenn.). 1972. Translation of pp 21-30 from the VGB Feedwater Conference, Essen, Germany, 1972. 37p. Dep. NTIS $4.00.

The water needs, extent of water use, and nature of water discharged in various types of power reactors are discussed. The conditions under which ion exchangers for water treatment have to work in the different types of plants are reviewed. Methods for overcoming special problems are described. (JWR)

26202 (CONF-730942-P3) STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY. Volume 3. Reactor Vessels. Part G. Structural Analysis of Steel Reactor Vessels. Part H. Structural Analysis of Prestressed Concrete Reactor Pressure Vessels. Preprints of 2nd International Conference, Berlin, Germany, September 10–14, 1973. Jaeger, T. A. (comp.). (Commission of the European Communities, Brussels (Belgium); Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)). 1973. 678p. (In several languages).

Separate abstracts were prepared for 58 of the 59 papers included. The remaining paper had previously been abstracted in NSA as 29: 07219. (JWR)

For abstracts of individual papers see: 24829, 24830, 25952–25957, 26000, 26001, 26031–26041, 26091–26093, and 26203–26236.

26203 (CONF-730942-P3, pp vp Paper G 1/1) STATIC, STABILITY, AND DYNAMIC ANALYSES OF SHELLS OF REVOLUTION BY NUMERICAL INTEGRATION: A COMPARISON. Svalbonas, V. (Grumman Aerospace Corp., Bethpage, NY); Key, J. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The use of numerical integration for the analysis of practical shell of revolution structures was documented almost simultaneously in the United States by three independent groups of researchers (Cohen, Kalnins, Mason et al.). These early efforts have been refined, reformulated, and increased in scope and applicability to become major program systems (SRA, Kalnins, STARS). While all three programs utilize basically the same mathematical formulation for integrating the shell differential equations, the matrix solution procedures from this point are basically different. The purpose of this paper is twofold as follows: (1) present the differences in solution procedures of the largest system (the Grumman–NASA "STARS") from the other two, and point out the inherent advantages of this approach; (2) compare the numerical integration procedure, as utilized in the "STARS", with finite difference and finite element procedures, noting the relative advantages of each in the analysis of shells of revolution for static, buckling, and dynamic loadings. A brief review of the numerical integration procedure for the analysis of shells of revolution is presented, and the matrix solution procedures of the SRA, Kalnins, and STARS programs are contrasted. The limitations imposed by the relative procedures are discussed. The unique formulation utilized by STARS for the solution of stability and vibration problems, and its advantages, are discussed in detail. The STARS program's analytical capabilities, capacity, and user options are compared with those of other major systems utilizing either finite differences or finite elements for the analysis of shells of revolution. Comparisons are made in terms of program size, program accuracy, number of degrees of freedom required for analysis, ease of idealization and user inputs, limitations imposed on analysis capability or output, running time, and so forth. All advantages and differences are demonstrated by use of solutions for realistic shell problems in the areas of statics, stability (including dead and live load distributions), vibrations, and dynamic response of shells subjected to time-dependent loadings. (auth)

26204 (CONF-730942-P3, pp vp Paper G 1/2) EFFECTS OF SHEAR AND NORMAL DEFORMATIONS IN AXIS-SYMMETRICAL LOADED CIRCULAR CYLINDRICAL VESSELS. Korman, T. (Purdue Univ., Lafayette, IN). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The basic problem in the shell theory is to reduce a three-dimensional problem to a two-dimensional one, i.e., to express stresses and displacements in the shell space through the deformations on the middle surface of the shell. In order to achieve this dimensional transformation it is common in the classical theory of shells to ignore the effects of normal and transverse shear strains and to assume also that the transverse normal stress is zero. Although the equations, which are derived on the basis of these simplifying assumptions, deliver reasonable results in cases of thin shells, the results are unsatisfactory for thick shells. Many authors have attempted to develop a theory of thick shells, in which the effects of shear and normal deformations and normal stresses are considered. The Equations of "Mathematical Exact Theory of Shells" of Zerna are taken as the basis for the equations developed in this paper. Since Zerna does not ignore the effects of shear and normal deformations, his equations can be employed to analyze vessels with thick walls. First the equations for an axis-symmetrical loaded circular cylinder are derived based on Zerna's "Mathematical Exact Theory of Shells". A circular cylinder under axis-symmetrical loading is calculated for various magnitudes of t/R (t = shell thickness, R = Radius) by using (1) these newly derived equations, (2) the thin shell theory, and (3) Finite Element Method which contains element stiffness matrix with shear deformations. The results are compared and the effect of shear and normal deformations is discussed for several ratios of t/R. (auth)

26205 (CONF-730942-P3, pp vp Paper G 1/3) ANALYSIS OF MODERATELY THICK FLANGED REACTOR PRESSURE VESSELS. Goldberg, J. E.; Yang, H. T. Y.; Pathak, D. V. (Purdue Univ., Lafayette, IN). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Moderately thick shells, especially shells of revolution, have a number of applications in nuclear power technology. The most apparent and most important of these applications is the steel reactor vessel, but a number of elements of ancillary equipment and conduits may also be classed as moderately thick shells of revolution. The reactor vessel is generally fabricated in three units, a dome or head which usually has a spheroidal or ellipsoidal shape, a cylindrical body, and a lower closure which also is essentially a shell of revolution. The units of the reactor vessel, the sections of conduits and the containers of ancillary equipment are conventionally provided with flanges at their boundaries and these elements are assembled into the system and interconnected with contiguous components by means of these flanges. The flanges require special attention in the design, and especially in the stress analysis of the system. Because of the abrupt changes in thickness and particularly the re-entrant corners in the flange cross section, stress concentrations occur in these elements and one finds that simple analytical methods such as may be used for preliminary design or approximate analysis are not entirely adequate and reliable for final analysis. In addition to concern regarding stress concentrations, it may be pointed out that the simple methods that are generally used for the analysis of flanges and for the analysis of discontinuity stresses in the neighborhood of flanges tend generally to underestimate the elastic compliance of the flange and thus may produce an erroneous calculation of stresses in regions of the shell beyond the immediate neighborhoods of the flanges. Interest in these matters has motivated the development of a procedure for calculating stresses and deformations in moderately thick flanged shells of revolution. The procedure combines the finite element method with the Goldberg-Bogdanoff numerical integration method for shells. In deference to the widespread familiarity with the finite element method on the part of engineers, ring finite elements are used to model the flange regions. Because of its efficiency, completeness and accuracy, the Goldberg-Bogdanoff numerical integration method is used in the shell portions of the system. The shell equations which are employed in the procedure include the principal effects of transverse shear deformation and the principal effects of transverse normal stress, and are therefore applicable to moderately thick shells. The loading may be symmetrical with respect to the axis of the vessel or shell, or it may be unsymmetrical. Geometric and material properties may vary rather arbitrarily in the medirional direction. Because the numerical integration scheme accommodates arbitrary meridional variations, the procedure may be extended to include symmetric plastic zones and symmetric zones in which the material properties have been modified by elevated temperature either entirely or partially through the thickness. (auth)

26206 (CONF-730942-P3, pp vp Paper G 1/7) APPLICABILITY OF VARIOUS NONHOMOGENEOUS ANISOTROPIC SHELL THEORIES IN PRESSURE VESSEL DESIGN. Widera, O. E. (Univ. of Illinois, Chicago); Chung, S. W. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

While many shell theories and solutions are available to the designer for conventional pressure vessel analysis, relatively little work exists for composite materials vessels. The fact that in composite construction the material properties have, in general, to be considered to be both anisotropic and non-homogeneous makes it difficult to derive shell theories by means of the classical method. This difficulty can, however, be overcome by using the method of asymptotic integration of elasticity equations. The asymptotic method is used to derive various first approximation theories, governing the unsymmetric deformation of non-homogeneous anisotropic cylindrical shells. The analysis is valid for materials which are non-homogeneous to the extent that their properties are allowed to vary with the thickness coordinate. The derivation of the shell theories is accomplished by first introducing the shell dimensions and as yet unspecified length scales via changes in the independent variables. Next, the stresses and displacements are expanded asymptotically in terms of a small geometric parameter. A choice of length scales is then made and corresponding to different combinations of these length scales, different sequences of systems of differential equations are obtained. Subsequent integration over the thickness and satisfaction of the boundary conditions yield the desired equations governing the construction of the shell stress states. For homogeneous isotropic material, the derived stress states are equivalent to those associated with the a) Donnell-Vlasov theory, b) simplified bending theory, c) membrane theory and d) semi-membrane theory. By including all terms necessary in the first approximation theories, a uniformly valid theory is also developed. The theories presented are then extended to laminated shells. The most general case of a layered shell, one that consists of an arbitrary number of layers of different thicknesses having an arbitrary arrangement, is considered. Each layer is assumed to be homogeneous, but anisotropic with an arbitrary orientation of the elastic axes. To illustrate the application of the derived theories, and to discuss their suitability for given loadings and shell dimensions, the problem of the laminated pressure vessel under combined loading is examined. The end conditions assumed are that the cylinder is clamped at both ends but free to rotate and extend or contract at one end. A comparison of the results obtained for a single isotropic layer, a single anisotropic layer, and for a four layer symmetric angle ply configuration (angle γ of elastic symmetry axes is oriented at $+\gamma, -\gamma, -\gamma, +\gamma$) clearly demonstrates the superiority of the angle ply configuration in providing additional stiffness with increase in angle of orientation. The presence of the edge effect and its change with angle of orientation is also demonstrated. The results show that the edge effect penetrates further into the shell for small orientation angles than for large ones. (auth)

26207 (CONF-730942-P3, pp vp Paper G 1/8) INFLUENCE COEFFICIENTS FOR AXIALLY SYMMETRICAL THIN SHELLS. Sutcliffe, W. J. (Univ. of Liverpool). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Application of available tables of Influence Coefficients to practical examples of shell structures gives rise to some errors and difficulties since due to the discrete nature of tabulations, interpolation is often required. In addition, some well known tabulations (G. D. Galletly) for toroidal and spherical shells are limited to open crown cases, i.e., a shell covering a full 90° of meridional angle cannot be dealt with owing to singularities which arise at the crown ($\phi = 0^\circ$ in the usual notation). (In addition, Galletly's formulation involved complex numbers.) Other tables (E. Y. W. Tsui), eliminate these singularities by the introduction of new variables. A simplified presentation of the relevant equations has been produced with the aim of avoiding the use of complex numbers or "auxiliary" variables, while retaining full capability for all meridional angles. Equations for the general shell of revolution are first considered and then detailed application and results for toroidal and spherical shells are given. Comparisons with selected tabulated results from other sources are made. The proposal is made that, as an alternative to the use of tables, a relatively simple computer program will produce, in a short running time, accurate values of Influence Coefficients, including an axial loading case, for any input of shell geometry and shell material properties. Runge-Kutta numerical integration has been used throughout and details are given of the considerable extent to which segmentation of shell elements has been avoided. Consideration is given to the accuracy of the formula for critical shell length as proposed by A. Kalnins and H. Kraus and a detailed analysis of the calculations involved in solving the equations for the boundary conditions is given. The well known tabulations of Influence Coefficients by G. D. Galletly cover cases of positive and negative curvature. Values are given corresponding to: loads perpendicular to the shell axis and edge moments, at both ends of the shell, and a pressure load case. Here, in addition to these cases, a further pressure loading case and an overall axial load case have been included. (auth)

26208 (CONF-730942-P3, pp vp Paper G 1/9) SHELL ANALYSIS THROUGH THE USE OF ASYMPTOTIC THEORIES. Widera, O. E. (Univ. of Illinois, Chicago). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In the last two decades or so, one of the main activities in the field of shells dealt with the derivation of approximate theories. These theories are in wide use, but because of their approximate character they often lead to failures which could have been predicted only on the basis of more refined theories. However, even the so-called refined theories are themselves derived from the exact three-dimensional elasticity equations on the basis of artificial assumptions whose validity is often open to question. Moreover, in the process of making these assumptions certain contradictions occur which have resulted in shell theories of great variety and complexity. The reduction of the three-dimensional equations of elasticity to an equivalent set of linear two-dimensional equations is based on the assumption that the shell be thin and that the displacements be small compared to the thickness. The classical derivation of thin shell equations incorporates hypotheses, such as those of Kirchoff, which lead to a priori assumptions regarding the spatial distribution of displacements and stresses over the thickness of the shell. Another method of deriving shell equations, one which is free from a priori assumptions, is that of the asymptotic integration of the elasticity equations. The method incorporates the use of the boundary layer technique to furnish, depending on the choice of characteristic length scales, different sequences of systems of differential equations. Subsequent integration over the shell thickness and application of the surface boundary conditions yields the desired two-dimensional shell equations. The lowest order system so obtained represents the simplest appropriate shell equations. The higher order systems systematically incorporate thickness corrections associated with the effects of transverse shear and normal stress. The application of asymptotically derived shell theories is demonstrated. The particular problem considered is that of a fixed-ended cylinder subjected to a constant line along a generator. The starting point of the analysis is a set of very general shell equations developed by Goldenveizer. The loading and solution state is represented in the form of a Fourier series in the circumferential direction. Depending on the number of circumferential waves considered, various simplifications of the general shell equations can be carried out on the basis of the results for the asymptotic theories. The complete solution is obtained by a superposition of the solutions of the simplified systems of equations. (auth)

26209 (CONF-730942-P3, pp vp Paper G 1/10) THERMAL STRESSES IN THIN CYLINDRICAL SHELLS. Wilson, J. D. (Central Electricity Generating Board, Berkeley, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In innumerable situations throughout nuclear reactor systems are found thin cylindrical shells which are subjected to various transient and steady state temperature fields. The following analysis allows evaluation of the resulting induced thermal stresses and deformations caused by several different temperature distributions. Temperatures are assumed to be functions of both the axial and circumferential coordinates of the cylinder but are considered to be constant with respect to the radial coordinate, that is constant through the thickness. This is a reasonable assumption when the vessel wall is thin in comparison to diameter. From consideration of equilibrium and compatibility of displacements of a thin elastic cylinder, capable of supporting bending stresses, differential equations are set up which represent the stress resultants in terms of the radial, axial and circumferential displacements. Three equations in terms of the above displacements and thermal and mechanical loading systems are also obtained. These equations are similar to those proposed by Fluegge with the exception of additional temperature terms. Mechanical loading such as dead weight and pressure are not included in this analysis, thermal effects are examined in isolation. Temperature distributions are represented by Fourier series in both the longitudinal and circumferential directions. Substitution of this double series in the three displacement equations followed by the solution of the stress resultant equations yields a set of double Fourier series which represent displacements and stress resultants in terms of the applied temperature distribution. The general form of the temperature series chosen permits simply supported cylinders to be analyzed, that is, the end profile cannot deform in its own plane, no rigid body displacement or rotation of the end profile occurs, generators are free to rotate normal to the end profile, and no axial force is applied. A computer program has been prepared to evaluate displacements and stress resultants using this approach and can be employed with any temperature field which can be represented by the general double Fourier series. (auth)

26210 (CONF-730942-P3, pp vp Paper G 2/1) ACCURATE DETERMINATION OF STRESS CONCENTRATIONS AROUND ELLIPTICAL HOLES IN CYLINDRICAL SHELLS. Murthy, M. V. V. (National Aeronautical Lab., Bangalore, India); Rao, K. P.; Rao, A. K. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The problem of stress concentrations around cutouts in thin shell structures is of considerable importance in reactor pressure vessels. While sufficient data are available in literature on circular cutouts, information on various types of noncircular openings is rather scarce. A theoretical analysis is presented for evaluating stresses around an elliptical hole in a cylindrical shell under axial tension with the major axis of the hole parallel to shell axis. Solution for the Donnel equations for a circular cylindrical shell is expressed in elliptic coordinates as an infinite series in terms of Mathieu and Modified Mathieu functions by the method of separation of variables. The solution is then reduced to a Fourier series and the boundary conditions are satisfied numerically term by term in the Fourier series. An earlier analysis by Venkitapathy for the same problem is found to be erroneous due to the omission of a part of the series solution. Results obtained for the complete range of $k(0 < k < 1)$ and for $0 < \beta \leq 2.5$ where: $k = b/a$, a = length of semi-major axis of hole, b = length of semi-minor axis of hole, β = curvature parameter, $\beta^2 = a^2(12(1 - v^2))^{1/2}/8Rt$, R,t = radius and thickness of shell, respectively, v = Poisson's ratio. A chart is presented from which the stress concentration factor can be directly read over the range of values of k and β mentioned. An interesting feature of the problem is that for each value of k, there exists a certain value of curvature parameter β at which the usual series solutions become numerically unstable, because the Mathieu equation has an infinite number of branching points on the complex plane. Such critical combinations of k and β need a separate treatment and this aspect is also discussed. The limiting case of an axial crack is a trivial one for axial loading case but is of great practical significance for internal pressure loading. E. S. Folias used the method of integral equations to predict singular stresses and the present authors gave a perturbation method, both applicable for small cracks. A much simpler and direct method is now offered which can be applied to small and large cracks. A chart is presented from which the stress intensity factor can be read for a wide range of values of numerical results also used to establish the range of validity of perturbation solutions for these problems. (auth)

26211 (CONF-730942-P3, pp vp Paper G 2/2) STRESS CONCENTRATIONS AROUND PLAIN AND REINFORCED HOLES IN CYLINDRICAL AND SPHERICAL SHELLS. Rao, K. P.; Prakash, P. (Indian Inst. of Science, Bangalore, India). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In general, cutouts are introduced in pressure containing structures for access or visibility. The resulting stress concentrations can be reduced by providing reinforcement around the opening. For an efficient design of cutouts and reinforcements, it is necessary to understand correctly the effect of elastic discontinuities. The analysis available in literature, especially on thin shells with non-circular holes, is valid only for small values of curvature parameter $\beta(\ll 1)$ defining the size of the hole in relation to the dimensions of the shell. A procedure is presented for the stress analysis of pressurized cylindrical and spherical shells containing curvilinear holes valid also for $\beta > 1$. The two shapes of holes considered are elliptical and square holes with rounded corners. Stresses and displacements at any point in the shell are obtained as a superposition of the stresses due to a circular hole and the perturbation stresses due to departure of the given contour from a circle. Only the first order perturbation is considered. Starting from Donnell's shallow shell equations in polar coordinates for a cylindrical shell with a hole, the solution is obtained in terms of Hankel functions of the first kind. The problem of a circular hole is solved first. The solution for a curvilinear hole is then obtained as a first order perturbation over the circular hole solution using conformal mapping technique. Boundary conditions are satisfied by a collocation procedure to obtain the unknown constants in the series solution. It is shown that Wittrick's optimum reinforcement for a $\sqrt{2}:1$ ellipse in a $2:1$ stress field does not lead to a nearly neutral hole in pressurized cylindrical shells which implies that flat plate solutions cannot be applied to shell problems. The effect of the mechanisms by which the pressure load over the hole region is communicated to the hole edge is also studied. A similar procedure is used for spherical shells starting from Reissner's shallow shell equations. The effect of all the parameters involved in the design of a reinforcement around the hole is studied in detail. The area and the moment of inertia of the cross-section of the reinforcement are found to play a significant role in reducing the stress concentration. It is found that the maximum membrane and bending stresses increase with increasing departure of the given hole shape from a circle. Graphs and tables are presented giving the stress concentration factors for various cases which are helpful in designing efficient reinforcements around holes in cylindrical and spherical shells. (auth)

26212 (CONF-730942-P3, pp vp Paper G 2/3) LIMIT IN-PLANE COUPLES OF NOZZLES IN CYLINDRICAL VESSELS AND BRANCH CONNECTIONS IN PIPING SYSTEMS. Ellyin, F. (Univ. of Sherbrooke, Quebec); Turkkan, N. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Nozzles in pressure vessels or branch pipes in piping systems are generally loaded by external forces as well as internal pressure. However, the magnitude of the external loadings cannot normally be determined. To evaluate the critical case, it is necessary to determine the limit loads due to each of the external loads, and their combination with the internal pressure. The case of a branch pipe or nozzle subject to an in-plane couple is considered. The magnitude of this couple which will cause "collapse" as defined by the limit analysis will be sought. This limit will be approached from below by using the lower bound technique. Using the limit couple as an objective function, a lower bound is found by maximizing the couple over a "statically consistent stress field" subject to inequality constraints imposed by the material yield condition. The results are valid for all diameter ratios, applicable to both nozzles in cylindrical vessels and branch pipes in piping systems. No safe (lower bound) solution for the title problem exists at the moment. It is believed that the solution presented is a pre-requisite in an over-all evaluation of the critical cases due to external loadings. The section III of the ASME Boiler and Pressure Vessel Code for Nuclear Vessels specifies that the limits on local membrane stress intensity and primary membrane plus primary bending stress intensity need not be satisfied, if it can be shown that the specified loadings do not exceed 2/3 of the lower bound limit load. In accord with the preceding paragraph, the need for a lower bound analysis becomes not only desirable but in a practical sense necessary. (auth)

26213 (CONF-730942-P3, pp vp Paper G 2/4) THERMAL STRESSES IN A NOZZLE-DRUM INTERSECTION. Fullard, K. (Central Electricity Generating Board, Berkeley, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Transient temperature variation through the walls of nozzle-drum intersections such as reheater outlets occurs during hot start-up conditions where the temperature of steam increases at a gradually decreasing rate over a period of some 30 minutes. The induced temperature variations give rise to thermal stresses which, on the inner surface of the intersection, tend to relieve the effect of steam pressure loading, but on the outside tend to aggravate the problem. The finite element method has been used to evaluate transient temperatures using the program FLHE and the associated thermal stresses using BERSAFE in a typical intersection. The intersection can be treated three-dimensionally or, more cheaply, by an axisymmetric approximation corresponding dimensionally to the nozzle-drum cross-section. Both models were investigated and the results compared for one start-up condition. The rate of start-up affects the temperature distribution through the structure. Fast start-up causes larger-than-normal temperature differences and hence the thermal stresses are more significant. It was found that the effect of doubling the start-up rate on the temperature distribution through the axisymmetric model was to increase the maximum temperature drop through the shell but to cause this to occur at slightly higher steam temperatures. The temperatures calculated by means of the axisymmetric model were found to compare closely with the temperatures at the cross-section of the nozzle-drum but were affected to a small extent by the distribution of heat transfer coefficients. The obvious alternatives are to use the distribution at the cross-section or to use an averaged distribution. It was found that the equivalent stresses on the outside of the intersection peaked in the region of the nozzle above the weld between nozzle and drum for both finite element models, the greatest outer surface equivalent stress in the three dimensional model was 1.7 times the value found with its axisymmetric model. Further, this stress occurred downstream of the intersection, the cross-section value actually being lower than predicted by the axisymmetric model.

It is concluded that axisymmetric models can be used to establish thermal stresses but the results have to be factored to give realistic values. (auth)

26214 (CONF-730942-P3, pp vp Paper G 2/5) EXPERIMENTAL STRESS ANALYSIS OF AN EQUAL DIAMETER CYLINDER–CYLINDER INTERSECTION SUBJECTED TO EXTERNAL LOADS. Moffat, D. G. (Univ. of Liverpool). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In recent years a great deal of effort has been directed towards the development of theoretical solutions, and the accumulation of experimental data to predict the elastic and post-yield behavior of cylinder/cylinder intersections subjected to internal pressure and external loads. Most of this work has been concerned with intersections having a mean diameter ratio dm/Dm ≤ 0.5, and it has been acknowledged recently that further work is required on the range $0.5 \leq$ dm/Dm ≤ 1.0. A program of tests now underway on a series of five equal-diameter, flush cylinder/cylinder intersections is described. Each of the five configurations has been carefully machined from carbon steel piping, prior to welding. The objectives of the tests are: (a) To obtain elastic stress concentration factors for internal pressure loading. (b) To investigate elastic stressing and flexibility of the junctions when subjected to a range of external loads. (c) To investigate the effects of superimposing internal pressure and external loads, and (d) To investigate post-yield behavior under internal pressure. Information will be obtained on shakedown and limit factors for each of the junctions in the series. The technique that has been developed for the external load tests is described. A series of adjustable flanges are employed, through which the various loads can be applied, thus obviating the need for a large complex loading frame. The results of the first of the external load tests for model number 3 are presented and discussed. (auth)

26215 (CONF-730942-P3, pp vp Paper G 2/6) INFLUENCE OF THE BOLT SYSTEM ON THE RESPONSE OF THE FACE-TO-FACE FLANGED CONNECTIONS. Pindera, J. T.; Sze, Y. (Univ. of Waterloo, Ont.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Influence of the bolt tensile stiffness and the bolt preloading on the response of the face-to-face flanged connections and flanges alone has been studied in full size steel and plastic models of bolted and boltless connections. The results show that bolt tensile stiffness and the bolt assembly forces are major design parameters since the elastic response of the flanged connection is influenced significantly by both these parameters. The influence of the variation of the axial shell force or of the internal pressure in the pressure vessel on the bolt working forces and on the deformation of the flanges significantly decreases when the bolt tensile stiffness and the bolt assembly forces increase. The bolt preload produces significant change of the geometry of flanges which result in a particular assembly stress state in the adjacent parts of the shell. The width and the location of the interface contact area depends mainly on the bolt preload and the bolt tensile stiffness. The elastic response of the bolt assembly as described by the tensile stiffness is nonlinear and depends strongly on the load level in some particular cases. Results indicate that model studies of such elastic systems shall be based on rigorous conditions of similarity. Consequently, the results of typical photoelastic stress freezing techniques cannot be—in general cases—either interpolated or extrapolated linearly. (auth)

26216 (CONF-730942-P3, pp vp Paper G 3/1) RELATIONSHIP BETWEEN NOTCHED BAR IMPACT BENDING TEST, ROBERTSON-TEST AND DROP-WEIGHT-TEST. Kochendoerfer, A. (Max-Planck-Institut fuer Eisenforschung, Duesseldorf); Hagedorn, K. E.; Kussmaul, K.; Kraegeloh, E. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

For the safety analysis of structures against brittle failure in most cases a combination of linear-elastic fracture mechanics and NDT-temperature is used. The latter is esteemed as a border temperature; if the temperature falls below, brittle fracture may occur. It is determined with the Drop-Weight-Test (DWT, according to ASTM E 208-69), substitutionally or for control with the notch impact bending test. Thus the temperature of the ISO-V notch impact strength 8.7 kpm/cm^2 may not exceed 33°C over NDT, as per ASME-PVC III, App. G (1972). The same range is proposed as safety against brittle fracture with tests (for instance pressure tests). The Robertson-Test determines the temperature, where a propagating crack is arrested. Supposing, a crack is initiated at an unfavorable part of the structure and does not lead to fracture if caught in tough matrix after a short distance, the temperature defined by the Robertson-Test is of decisive importance. Tests with the steel 22 NiMoCr 37 show no correlation between the crack arrest temperature of the Robertson-Test, DWT and the notch impact strength. A NDT temperature of −30°C was determined with the DWT, whereas a temperature of +30 to 35°C resulted in the Robertson gradient test, when the mode of fracture shifted. On the other hand, the temperature of the 8.7 kpm/cm^2 notch impact strength was below the 33°C limit (NDT + 33 = +3°C). The examination of the fracture surfaces in the scanning electron microscope (SEM) yielded the following result: with the Robertson gradient test the fracture shifts from cleavage to ductile dimpled fracture. Supposedly, a reduction of fracture speed should result. But the crack did not arrest before the temperature had reached +61°C, when the fracture had already shifted into a shear mode. Caused by the resulting macro-deformation, the stress fell below the critical value. There is no corresponding shift with the DWT at −30°C. Comparing tests with specimens having the full wall thickness of the Robertson specimens (30 mm) show, that the cracked area diminishes with increasing temperatures. Even at +10°C cleavage still is dominant, although the cracked area is small. It seems more favorable to define the NDT temperature by another criteria than specified in ASTM, or to use a larger temperature addition for brittle fracture safe structures, than given by ASME. This, for instance, may be the temperature corresponding to the crack arrest immediately behind the hard tack weld, if a definition by SEM is abandoned for technical reasons. A corresponding comparison with notched bar impact bending test specimens is less clear, as here the amount of cleavage in the fracture surface is influenced to a great deal by the size and the previous deformation of the specimen. (auth)

26217 (CONF-730942-P3, pp vp Paper G 3/6) MECHANICAL PROPERTIES IN THE HEAT AFFECTED ZONE OF WELDS IN STEEL 22 NiMoCr 37. Klausnitzer, E.; Gerscha, A.; Kristof, H. (Kraftwerk Union AG, Erlangen, Ger.). 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In the heat affected zone (HAZ) of welds made in steel 22 NiMoCr 37 small cracks may sometimes occur. These cracks correspond to brittleness during annealing in the temperature range around 600°C. For the safety analysis of reactor components the mechanical properties of the HAZ have to be determined. The width of the HAZ is only a few millimeters. Besides this the mechanical properties in the HAZ change rapidly. For these reasons special kinds of specimens have to be used for different tests. The investigations have been carried out on original HAZ of claddings and butt welds as well as on simulated heat treated test material in the stress relieved condition. The test results show the following: (a) Yield strength and ultimate strength increase rapidly; (b) Elongation and reduction in area decrease slightly in the HAZ as compared with the base material; (c) Impact strength reaches nearly the same values as the base material, after stress relief annealing; (d) Nil Ductility Transition Temperature in the HAZ is comparable with the base material; (e) The fatique tests conducted under simulated reactor operation conditions of stress and number of cycles and which included the required safety factor showed no deterioration of the specimens; (f) Crack growth rate is slightly higher than in the base material; and (g) Fracture toughness results are within the scatter band for the base material. On the basis of the test results it is concluded that brittleness in the HAZ only occurs at the stress relieving temperature. At reactor operation temperatures the mechanical properties of the HAZ are nearly the same as those of the base material. However, a slight deterioration of the mechanical properties which was actually determined does not affect the safety of the components. (auth)

26218 (CONF-730942-P3, pp vp Paper G 3/7) INVESTIGATIONS ON CRACKING AND EMBRITTLEMENT DURING STRESS RELIEF HEAT TREATMENT OF WELDED PRESSURE VESSEL STEELS. Banga, R.; Bertram, W.; Detert, K. (AEG-Telefunken, Frankfurt am Main). 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

It is a common practice to use weld constructions and weld platings in fabricating thick walled pressure vessels for light water nuclear reactors. The stress present after welding is reduced by a post weld heat treatment usually at an annealing temperature of 600°C. Cracking has been observed to take place during stress relief in welded assemblies of low alloy steels. The cracks are confined to the coarse grain regions of heat affected zone (HAZ) of weldments. Fine grained structural steels with about 0.18% C and low contents of alloying elements as Ni, Cr, Mo and V have been investigated. The HAZ has been simulated by heating up to temperatures above 1250°C and water quenching. The heat treatment has been found to be adequate and gives rise to a martensitic microstructure transformed from coarse austenite grains. The structure has been subjected to annealing under the influence of applied stresses as well as in absence of any outer stress. Embrittlement is found to occur in such structures during annealing depending on alloy contents of steels. However the growth and nucleation of cracks during stress relief is a phenomenon resulting from the specific creep behavior of certain metallurgical structures. The intergranular cracks along the primary austenite grain boundaries are initiated by grain boundary sliding and failures are not necessarily connected with a loss in ductility as measured by toughness testing. It is discussed how triple point cracks may form at former austenite grain boundaries in heat affected zones during stress relief annealing. The influence on the strength of welded constructions due to the presence of such small cracks is discussed and the measures to be taken to avoid those cracks by means of proper welding procedures are outlined. (auth)

26219 (CONF-730942-P3, pp vp Paper G 3/8) SOME EXPERIENCES IN TESTING OF WELDMENTS AT REACTOR COMPONENTS OF STEEL OF THE TYPE 22 NiMoCr 37. Trumpfheller, R. (Technischer Ueberwachungs-Verein eV, Essen). 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In the testing of weldments in reactor components of Type 22 NiMoCr 37 steel and of the corresponding ASTM A 508 Class 2 steel, cracks have been detected in the heat influence zone which apparently have developed during the annealing treatment. The different crack phenomena are described, and questions resulting from these discovered faults with regard to the engineering safety evaluation are discussed. Investigations aiming at an answering of these questions have been started. (auth)

26220 (CONF-730942-P3, pp vp Paper G 4/2) STRESS CONCENTRATION THEORY OF FRACTURE AND ITS APPLICATION TO VARIOUS CRACK GEOMETRIES. Irvine, W. H. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

By considering the elastic-plastic stress distribution occurring at the crack tip region, in real materials, such as steel, to be capable of being expressed in terms of a Hookean elastic distribution, it has been possible to use the Westergaard expression for the crack tip stress under elastic conditions in conjunction with the effective stress concept of Neuber to derive an exact expression for the onset of fast crack propagation in terms of two basic material parameters, i.e., the engineering Ultimate Tensile Strength (UTS) and a distance S in front of the crack tip, over which the average stress at fracture is equal to the UTS. It is shown that if application is restricted to stress levels of practical interest in engineering, i.e., between UTS and half the UTS, this concept and equation are, for practical purposes, equivalent to considering the load shed by the cracked material to be carried completely by the crack tip region S. This approximation provides a convenient physical concept which may be used for treating complex flaw geometries and stress distributions. When the Neuber or effective stress concept is combined with the particular approximation to Westergaard's expression used in Linear Elastic Fracture Mechanics (LEFM), an expression is obtained which is only valid at low stress levels. Comparison of this with the exact expression and its high stress range approximation highlights the limited range of validity of LEFM. The analysis is applied to several crack geometries and to the treatment of cases involving stress gradients and limited section size. Failure data and overall behavior of 6" thick tensile specimens, containing part circular surface flaws, and tested as part of the U.S.A.E.C.'s Heavy Section Steel Program is shown to be in good agreement with predictions based on this stress concentration theory and material data derived from standard tensile and Charpy tests. (auth)

26221 (CONF-730942-P3, pp vp Paper G 4/3) EXPERIMENTAL INVESTIGATIONS OF PART-THROUGH CRACKS IN PLATES AND THICK-WALLED SHELLS. Sommer, E. (Institut fuer Festkoerpermechanik, Freiburg, i. B.); Ratwani, M. 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The initial flaw in a structural component is usually part-through which may be caused by welding or other defects due to manufacturing or damage due to shipping or construction. The strength of such structural parts is considerably reduced by the presence of such flaws. Hence, the study of such defects is of considerable importance to designers. These crack-like surface defects may be regarded as part-through cracks. A single parameter which gives an idea about fracture and fatigue crack propagation of these cracks is the stress intensity factor. However, in fracture mechanics not much work has been done on part-through cracks particularly in shells because of mathematical difficulties involved in the problem. It has been shown by several investigators that the fatigue crack growth behavior of shells can be predicted from that of flat plates of same material and thickness provided the stress intensity factors in shells are known. In the present studies use is made of this idea to determine, from fatigue crack propagation rates, the stress intensity factors for part-through cracks in plates and shells experimentally. Fatigue crack propagation rates are obtained for part-through cracks in plates and shells and plates with edge-cracks. The technique employed for obtaining crack propagation rates for part-through cracks consists of putting markings at the crack front by changing load amplitude after a certain number of fatigue load cycles. After the fracture of specimen, the crack propagation rates are calculated by measuring the distance between the markings and knowing the number of cycles at every marking. Using a fatigue model, the crack propagation rates in plates and shells with part-through cracks and edge crack specimen are compared and the stress intensity factors are then calculated for various sizes of part-through cracks. (auth)

26222 (CONF-730942-P3, pp vp Paper G 4/5) AXIAL CRACKS IN CYLINDRICAL SHELLS SUBJECTED TO THERMAL AND MECHANICAL LOADS. Zika, M. J.; Ariman, T. (Univ. of Notre Dame, IN). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Cylindrical shells find frequent application in nuclear reactors as portions of containment vessels, supply skirts, coolant and flow inlet and outlet nozzles, fuel sleeves and moderators. In many of these usages such shells are subjected to thermal gradients as well as various mechanical loads. Fracture of reactor vessels under such loadings as a complete cylindrical is treated for the first time. Previous analyses owing to the use of Donnell's or Marguerre's Equations, effectively consider initially curved plates. In this presentation the governing shell equations are Morley's, formulated in terms of the radial displacement and a stress function F. The equations are first solved for a complete shell, then stresses are relieved along the crack edges by superposing canceling edge loads along the crack so that the boundaries are stress-free. This method results in a pair of coupled dual integral equations, which are converted into two coupled singular equations containing Cauchy-type singularities. Griffith-Irwin fracture theory is used by averaging the stresses calculated over the thickness of the shell to obtain an appreciation of crack propagation criterion. For the first time a complete cylindrical shell is considered including the effect of ring stiffness in the shell. In this treatment it is no longer specified the in-plane shear stress resultants are equal. Two particular types of loadings are included (1) internal pressure and (2) linearly distributed temperature variation throughout the shell thickness, extensive numerical results are presented and compared with earlier published works. (auth)

26223 (CONF-730942-P3, pp vp Paper G 4/9) CRACK GROWTH ANALYSIS IN CLADDED REACTOR COMPONENTS BY MEANS OF FRACTURE MECHANICS. Neubrech, G.; Vasoukis, G. (Kraftwerk Union, Erlangen, Ger.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The safety of components against intolerable crack growth can be predicted by means of fracture mechanics. In order to show the accuracy of these predictions, failures of real structures have to be analyzed. Sometimes the applicability of fracture mechanics theory is questioned because of discrepancies between theoretical and experimental results. The criticism of the theory, however, is not justified unless the correct application of the theory is examined carefully. Fracture mechanics equations are rather simple, but a lot of parameters and influences are more difficult to assess. The growth of a flaw situated under the cladding of a simple structure similar to a reactor component wall is analyzed. First the behavior of the crack is limited by a very conservative solution and by a most favorable estimation. Both these curves (crack size versus cycles) are identical at the beginning whereas they diverge extremely at an increasing number of cycles. Then the measured values between these extremes are met with more detailed, realistic assumptions. For safety evaluations, conservative solutions have to be used whereas a failure analysis has to show both the extremes between which the real defect behavior is expected. On the basis of the measured crack growth in the specimen and on the basis of the particular geometry and assumed loading history of a steam generator wall, it is possible to estimate the growth of an undercladding crack. (auth)

26224 (CONF-730942-P3, pp vp Paper G 5/3) FINITE ELEMENT CALCULATION OF STRESS INTENSITY FACTORS USING ENERGY TECHNIQUES. Hellen, T. K. (Central Electricity Generating Board, Berkeley, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The importance of fracture mechanics techniques for the design of structures containing cracks has increased considerably in recent years. For brittle materials, where plastic yielding in crack tip regions is very small, the conditions of fracture are assessed on the magnitude of the stress intensity factor at any instantaneous crack tip position. If this value exceeds an experimentally determined critical value, then crack instability exists. Analytical methods exist for calculating the stress intensity factors of various crack configurations in simple-shaped structures under certain loading conditions. However, for arbitrary structures under general loading, more sophisticated calculation techniques are required. In particular, the versatile finite element technique may be applied to two- and three-dimensional problems. From finite element results, several choices for calculating the stress intensity factor exist, the best of which involve energy considerations. A particularly accurate energy technique is to evaluate the strain energy change for a small crack extension known as energy release rate. A method is presented for extending any standard finite element program using a direct Gaussian elimination equation solver to automatically calculate the strain energy at two very close crack tips and then derive the stress intensity factor. Standard techniques require manipulation or integration of the displacements and stresses around the crack tip to derive the stress intensity factor, sometimes in scattered form. The proposed method requires slightly more computer time for a complete solution for displacements and stresses, but one accurate value of stress intensity factor is produced. In fact, this value is calculated at the end of the forward elimination irrespective of loading and boundary conditions, and so if the extra calculation of displacements and stresses is not required, the back-substitution phase of the computation can be suppressed, resulting in much less computer time than for a standard run. Previous energy difference techniques required two full computer runs for each small crack extension. The main advantage of the relatively high accuracy of the proposed method is that for practical tolerances, coarser meshes can be used. In particular, high order isoparametric elements are suitable. Crack growths can thus be followed with only very local mesh alterations and more economic three-dimensional solutions are possible. Numerical examples using the proposed method are given. (auth)

26225 (CONF-730942-P3, pp vp Paper G 5/4) APPLICATION OF THE FINITE ELEMENT METHOD TO THE ANALYSIS OF FRACTURE OF CYLINDRICAL SHELLS. Ando, Y. (Tokyo Univ.); Yagawa, G.; Okabayashi, K. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In the application of fracture mechanics to the prediction of strength and life of cracked structures, a knowledge of the stress intensification introduced by given defects as a function of applied load and geometry of the structure becomes necessary. The importance of the problem, particularly in the pressure vessel and piping design, is well known and has promoted a great deal of research, results of which are gradually adopted in the process of design. Unfortunately, in the case of complicated geometry such as shell structures with cracks, it becomes extremely difficult to derive an exact solution, especially for a large value of correction factor for the given geometry, which is defined as a function of length of crack, thickness, and curvature of a shell. Existing analytical stress intensity factors for the shell structures are the product of analysis for idealized model configurations and loading conditions. In various real situations, however, it is impossible to find suitable model representation for which an exact solution is available. Consequently, in order to evaluate stress intensity factors in such cases it becomes necessary to develop approximate numerical methods. One such method and its application will now be presented for shell structures. In these five years, various investigators have shown fairly good agreement of stress intensity factors calculated by the finite element method where exact solutions are available. Some numerical examples for a cracked cylindrical shell which are based on the mixed type finite element method are presented. An experimental investigation has been performed to show the validity of the computed stress intensity factor to the fracture of the cylindrical shell. The test is conducted on AISI 304 stainless steel pipes with artificial through-thickness crack of 300 and 500 mm length, 316 mm of diameter, 8 mm of wall-thickness and total axial length of 2030 mm. The effect of ambient temperature on the test results is also studied. The objective of the stress intensity factors calculated in the first part of this paper is to provide the theoretical information which can be used in predicting the fracture behavior of shells from that of flat plates and the stress-strain relations by simple tension tests of uniaxial bars under the various ambient temperatures, which may be obtained by relatively simple laboratory tests. (auth)

26226 (CONF-730942-P3, pp vp Paper G 5/5) FINITE ELEMENT ANALYSIS OF CRACK PROPAGATION IN THREE-DIMENSIONAL SOLIDS UNDER CYCLIC LOADING. Bergan, P. G.; Aamodt, B. (Univ. of Trondheim, Norway). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

An efficient computational procedure for analyzing crack propagation in solids is described. The method is general; however, its application to semi-elliptical surface cracks in thick plates is discussed in particular. The strain energy release rate G for a crack in mode I is a function of the crack geometry, the direction of crack propagation and the state of loading. When G is known, the stress intensity factor K_I can easily be obtained. The strain energy of the plate is computed numerically for a wide range of crack geometries using the finite element method. A 20-node isoparametric solid element is employed in modelling the structure. Certain special techniques for increasing the computational efficiency of the method, such as multilevel subdivision of the structure (substructuring) and condensation of degrees of freedom that are not needed in the crack propagation analysis, are emphasized. In fact, analysis of a large number of crack geometries requires only insignificantly more computational efforts than treating a single crack. Certain other aspects of the finite element modelling are also discussed. Two methods for replacing the computed discrete values of strain energy by continuous functions are presented. These functions are expressed in terms of the two half-axes defining the geometry of the elliptical crack and they are determined using a least square technique. G and K_I are easily deduced from these functions. As an example, a semi-elliptical, part-through, surface crack in a thick Ni-steel plate is analyzed. The crack is subjected to a combination of axial and bending loading. The load is applied cyclically. From the finite element calculations of the strain energy and the stress intensity factors which are computated accordingly, crack propagation along the two half-axes of the ellipse is calculated by utilization of a formula suggested by Paris. The results are checked against laboratory fatigue tests. The method has proven to be very efficient and accurate. Due to its generality it can also be applied to complicated geometries and complex states of loading. (auth)

26227 (CONF-730942-P3, pp vp Paper G 5/7) TECHNICAL APPLICATION OF FRACTURE MECHANICS TO THE SAFETY ANALYSIS OF NUCLEAR REACTOR COMPONENTS. Bartholome, G.; Vasoukis, G. (Kraftwerk Union, Erlangen, Ger.). 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

From the numerous examples of the application of fracture mechanics in nuclear reactor technology some selected examples are demonstrated: (1) Crack arrest criteria for brittle fracture—To assure crack arrest of unstable cracks the nuclear reactor components are operated in a stress and temperature range which is defined by the transition temperature approach; (2) Crack instability criteria for brittle fracture—The application of crack instability criteria, as it is recommended in ASME-Code, Section III, Appendix G, is shown for heat up, operation and cool down. For given stresses (pressure and temperature) and a given flaw size (crack depth equal to 25% of the wall thickness) the stress-intensity factors are calculated; (3) Hydrostatic tests for first shop testing and inservice inspection—By means of fracture mechanics the benefit of the hydrostatic proof tests can be evaluated. According to ASME-Code section III and XI the procedures are applied and evaluated. Safety factors against failure in operation and during hydrostatic testing are shown for unirradiated and irradiated conditions; (4) Ductile fracture criteria—The maximum critical crack length for a through crack is calculated for ductile failure; and (5) Leakage area—For the design of supporting systems, biological shield and concrete structures, the knowledge of the maximum leakage area due to ductile instability is required. For the above calculated crack length the crack opening displacement is determined by fracture mechanics equations with plastic corrections. From this the leakage area is calculated. (auth)

26228 (CONF-730942-P3, pp vp Paper G 6/4) EVALUATION OF CRACKS FORMED DURING HEAT TREATMENT FOR STRESS RELIEF BY ACOUSTIC EMISSION. Jax, P. (Battelle-Institut, Frankfurt am Main). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A new nondestructive testing (NDT) method—the acoustic emission analysis (AEA)—was applied to the problem of detecting undercladding cracks in reactor steel A508 Class II with overlay welds. This was made by measuring acoustic emission during the heat treatment for stress relief of clad blocks. The results of the AEA were compared with those of other NDT methods and micrographs. It was found that AEA is a quite sensitive method for detecting cracks. The extent of crack formation can be qualitatively predicted by an acoustic emission parameter, the number of total emission counts during the heating period. By this method it is possible to classify the cracks roughly into different sizes. Especially a reasonable value of the acoustic emission parameter for industrial quality control can be given. Due to the principles of the method, the AEA is able to follow crack formation during the whole heat treatment and to give detailed information of the kinetics of cracking in dependence of time and temperature: Undercladding cracks in reactor steel are not formed in the period of heating-up the blocks, but at the final temperature of the heat treatment. The velocity of crack formation in this stage gradually increases from zero to a maximum, which is reached after an incubation time of 2–4 hr at 600°C, and decreases then continuously—also during further heat treatments. These results are in good correspondence to existing theories about the cause of undercladding cracks. To study in more detail the mechanism of crack formation, acoustic emission was measured during creep tests of specimens, which had a similar heat treatment and structure as the coarse grained heat affected zone of the clad blocks. According to the AEA and to photographs, microcracks are already formed after times of less than 30% of rupture lifes. The rupture of the specimen is announced by an increase of acoustic emission activity, that means in this case a range of macroscopic crack formation, which takes nearly 7% of the total rupture life. It was found by acoustic emission analysis that crack propagation along a grain boundary cannot be spontaneous, but must proceed in steps. (auth)

26229 (CONF-730942-P3, pp vp Paper H 2/4) INELASTIC BEHAVIOR AND FAILURE MODES OF PRESTRESSED CONCRETE VESSELS. Fluge, F.; Gausel, E.; Lenschow, R. (Univ. of Trondheim, Norway). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Behavior in the inelastic range to rupture on four pneumatically loaded model vessels is described. The geometry of the models is scaled 1:3.6 to the Scandinavian PCRV-model (reference pressure 84 kp/cm^2). Geometrical data: internal height: 111 cm, internal diameter: 55 cm, liner thickness: 0.3 cm, cylindrical wall thickness: 30 cm, thickness of the top and bottom slabs: 33 cm. No. 3 was supplied with curved cables and additional bonded reinforcement to strengthen the corner region, but did not result in the foreseen increase in the ultimate pressure compared with No. 1. While model No. 1 and No. 2 started cracking in the end region at approximately 150 kp/cm^2, a 15 percent increase in circumferential prestressing forces on the end slabs of model No. 3 and No. 4 prevented visible cracks up to failure load in this zone. Model No. 2 and No. 4 were nearly balanced designed with respect to the ultimate state. A 15 percent change of the amount of prestressing reinforcement in the wall caused the failure location to shift from the top slab (corner region) of No. 2 to the wall of No. 4. A calculation of the cylindrical wall using a kinematic chain having several links is discussed. Calculations of the pressure/deformation relation for the plastic range up to failure are presented. Diagrams of total deflections up to failure (max. deflection about 75 times the deflection at reference pressure) are presented together with corresponding strains measured on liner and bonded reinforcement, and are compared with computed values. Possible modes of rupture are discussed on the basis of the present investigations. (auth)

26230 (CONF-730942-P3, pp vp Paper H 3/2) ASSESSMENT OF BOUNDS ON STRESSES IN PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS. Irving, J.; Carmichael, G. D. T. (Central Electricity Generating Board, Berkeley, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The significance of the mechanical behavior and condition of concrete on the stresses and deformations in prestressed concrete reactor pressure vessels is discussed with reference to the loading history. Approximate solution techniques for stress and strain analysis currently in use are briefly described and their relative merits are discussed. Earlier work is referred to in which it has been shown that it is important, when evaluating vessel stresses and deformations occurring over a long period of time, to take into account the effect of previous loadings on the capacity for creep under subsequent loadings. In order to determine the effect of previous loadings in a simple manner an approximate uniaxial strain response function is used to derive curves from which the transient stress behavior due to creep in plain, prestressed and reinforced concrete structures can be determined. It is deduced from these curves that, although bounds on stress can be derived for reactor start-up conditions (initial elastic solution), and for long term reactor operation (steady state solution), the creep capacity may not be sufficient for the long term bound to be very closely approached. It is concluded from the results presented that it is important, when investigating long term behavior, to assess the closeness of approach to the long term bound in the light of true creep capacity, otherwise an overly pessimistic view of long term vessel stresses could be obtained. (auth)

26231 (CONF-730942-P3, pp vp Paper H 3/3) ANALYSIS OF PRESTRESSED CONCRETE PRESSURE VESSELS WITH WIRE WOUND PRESTRESS. Burrow, R. E. D.; Crowder, R. (Taylor Woodrow Construction Ltd., Southall, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

New information comparing certain important features of vessels prestressed by conventional linear tendons and using tendons wound into channels on the external surface of the structure is presented. Stress analyses for both configurations are compared and points of design are identified which have special significance in wire wound vessels. The subjects discussed include the design treatment of stress concentrations and tensile stress zones, the local effects of wire wound bands and factors affecting the distribution of stress through the thickness of the vessel walls. The prestress level in the central region of the end caps of vessels prestressed by external windings is discussed, and the effects of construction sequence and vessel operation on the stresses in this area are assessed. Some aspects of overload conditions are considered which have special bearing upon the design of wire wound vessels. The treatment of potential liner leakage and ultimate pressure adopted in the forthcoming British Standard Specification for prestressed concrete pressure vessels for nuclear reactors is described and appraised. The strength of a vessel may be limited by the possibility of local failure. Certain examples of this are discussed and recommendations made for their treatment. These include the postulate of horizontal shear failure at the junction of cap and barrel, failure by extrusion of part of the vessel wall between winding bands, and cap failure in the shear mode. Components of vessels may also be stressed by wire winding and the design criteria adopted in the design of such a component for the Hartlepool and Heysham boiler closures are described and discussed. As a natural sequel to the comparisons offered, an attempt is made to reassess the efficiency of designs prestressed by wire wound and linear tendons, in a new discussion and quantitative appraisal of both styles. It is concluded that wire wound tendons show significant economies over corresponding linear tendons, and that when consequential economies are considered the choice of this method as a standard feature of high pressure primary containment vessels appears likely. (auth)

26232 (CONF-730942-P3, pp vp Paper H 4/1) EXPERIMENTAL AND THEORETICAL STUDY ON A 1/10TH SCALE MODEL PCPV. Kuroda, T. (Electric Power Development Co., Ltd., Tokyo); Ohnishi, S.; Hisatomi, Y.; Isobata, O.; Eadie, D. M. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The test of a 1/10th scale model PCPV when pressurized to design and ultimate pressure and comparison of the test results with those predicted by analyses are described. The model is a close representation of the PCPV of the Hinkley Point B Power Station, i.e., a cylindrical vessel with flat end slab where the prestress is provided by a helical tendon system. The large scale test was the first in Japan conducted to measure the deflection, strain and crack distribution of the model when pressurized incrementally to design pressure (43 kg/cm^2) and to ultimate pressure (129 kg/cm^2) at ambient temperature. Both elastic and elasto-plastic analyses based on finite element method were applied to predict the response of the model where it was treated as an axisymmetric body of revolution. Two computer codes were developed for the elastic analysis, one employing the constant strain elements and another variable strain elements. In addition, two-dimensional analysis by the finite element method was applied to estimate the stiffness of the top slab. The test results indicated that the behavior of the model up to the design pressure was elastic, while the behavior beyond design pressure is such that the first tensile plastic area in the top slab occurred at 1.5 times of the design pressure, and the outer surface cracks on the wall at 1.85 times and the final fracture of the model at 3.0 times of the design pressure. Deflections of the top slab center and the midheight wall at the maximum internal pressure, reached to 26 and 38 times of those at the design pressure respectively. There was generally good agreement in both displacement and strain between the test results and theoretical predictions, and thus the validity of the analytical methods which the authors developed was confirmed. Comparison was also made between the results of this study and the previous British test, and there was good correlation between these two results. In summary, it is apparent that the behavior of the PCPV within design pressure and to failure can be satisfactorily predicted by analytical methods and the progressive failure mode and high safety factor of the PCPV were ensured. (auth)

26233 (CONF-730942-P3, pp vp Paper H 4/10) FEASIBILITY OF MEASUREMENTS ON CAVITIES ESPECIALLY ON THE LINER OF PRESTRESSED CONCRETE PRESSURE VESSELS OF NUCLEAR REACTORS. Magiera, G.; Czaika, N. (Bundesanstalt fuer Materialpruefung, Berlin). 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

For the assessment of Prestressed Concrete Pressure Vessels (PCPV) it is necessary to measure strains, deflections, temperatures, etc. on the liner of PCPVs. Because of considerable difficulties in measuring on the internal side of the liner, the measurements must be performed in the boundary layer of the liner and the concrete. For this purpose cavities (behind the liner in the concrete) are made for the transducers. These cavities could be a danger for the liner of the vessel, since during the prestressing of the vessel the liner is strained over the elastic limit into the plastic range. This prestressed liner could be pressed by the internal pressure of the vessel into these cavities. Thus it is possible that cracks could appear and endanger the vessel, and that the values of strain and deflection measurements of the liner could be falsified by the cavities. Experiments to test these possibilities had to simulate three variables: prestress of the liner, internal pressure, and the area of the cavities. In the experiments a round formed model of the liner was made and placed on a steel support with cavities of different sizes. The steel support simulated the concrete body. The model was loaded by a pressure up to 700 bar [4900 psi]. For simulating the prestress of the liner a steel ring on the round formed liner gave different prestresses from 0 to larger than the yield stress of the liner steel. Results show that the strain falsification is negligible (independent from the prestress) if the thickness of the liner is larger than 20 mm, and the internal pressure of the PCPV is smaller than 50 bar (350 psi), and the area of the cavity is smaller than a defined size. However, if the internal pressure rises to about 500 bar (3500 psi) and the area of the cavity also increases there is a large dependence on the prestress of the liner. The functionality of strains as a function of the area of the cavity, of internal pressure and of the prestress of the liner is shown. (auth)

26234 (CONF-730942-P3, pp vp Paper H 4/11) FLUIDIC SYSTEM FOR LONGTERM MEASUREMENTS OF SEVERAL VARIABLES IN HIGH-TEMPERATURE NUCLEAR APPLICATIONS. Mayer, N. (Bundesanstalt fuer Materialpruefung, Berlin). 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The measuring principle of the described fluidic system is as follows: The massflow through a nozzle at choked flow conditions is controlled by a movable valve needle. By the use of a simple mechanical linkage the position of this needle in turn is a function of the physical property to be measured, e.g., position, strain or temperature. A second nozzle with constant cross-section is arranged within the sensor in good thermal contact to the controlled nozzle. With a paraboloidic needle shape the ratio of the massflows through the two nozzles is proportional to the measured variable. With properly matched nozzle shapes and pressure ratios it is possible to get an output signal largely unaffected by the supply pressure, the atmospheric pressure, the temperatures at all positions at the system, the fluid line resistances and the nature of the working gas. Instead of measuring the massflow directly it is possible to arrange two additional nozzles together with the sensor nozzles in a bridge circuit analog to a Wheatstone bridge. Using a micrometer valve for one of the additional nozzles this bridge can be balanced manually. In the balanced condition the position of the valve stem is proportional to the position of the sensor needle. Automatic balancing of the bridge is easily provided by a bellows actuator and an electric position sensor gives an electric output signal for data processing. Fluidic diodes protect the bellows from overpressure conditions. At a first design step switching of up to 12 sensors to the balancing circuit is provided with a solenoid-controlled scanning device. The sensing device of this fluidic circuit can be matched to sense position, strain, temperature and other variables. Some details about the construction of the sensors are given. Preliminary details on the behavior of the whole measuring system at room temperature and for some measurements at temperatures up to 400°C are presented. First application results for the measurement of strain in PCPV-models at high temperatures are presented. For some applications this system may be better qualified than electric measuring systems due to the high inherent stability of the sensor against high temperatures and high nuclear radiation levels. (auth)

26235 (CONF-730942-P3, pp vp Paper H 5/2) THERMAL BUCKLING OF STUD SUPPORTED LINER SHELLS. Kicher, T. P.; Esselman, T. C.; Gratzinger, R. J. (Case Western Reserve Univ., Cleveland). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The buckling and post buckled behavior of liner shells for concrete containment vessels have been examined both analytically and experimentally. Earlier work is extended to include the effects of biaxial loading and anchor flexibilities. This analysis method is based on the theories of minimum potential energy and an assumed displacement state. First a displacement pattern representing the experimentally observed out-of-plane displacement is determined. The associated membrane displacements are determined from the nonlinear equilibrium equations for cylindrical shells. Then the total displacement state is used to generate a potential energy function. The minima of this function are the equilibrium positions. The pre and post buckling response of the system are obtained by numerical solution and buckling is defined using Tsien's lower bound criteria. Using this basic analysis scheme, two major tasks on the buckling of liner shells are reported. An analysis for complete cylindrical shell elements anchored with rigid studs and subjected to biaxial loads is presented. A displacement state which satisfies two zero slopes and a zero displacement at the studs is assumed. Several distinct modes of buckling were found and the critical mode identified. Experiments on models of complete cylindrical shells subjected to thermal loading are summarized and correlated with analytical predictions. Design charts for determining rectangular stud spacings for various combinations of biaxial load are obtained. A one-dimensional beam model for liner shells with flexible anchors is also presented. A displacement pattern for a segment of a liner supported by elastic studs is assumed. Stud stiffness properties were obtained by a simple stress analysis model and confirmed by experimental data from the literature. Liner and stud loads before and after buckling were predicted from the assumed displacement pattern. Combinations of mechanical and thermal loading were used to determine the buckling loads experimentally. The effects of anchor flexibilities on the buckling loads and the anchor loads after buckling were measured experimentally. Design charts for estimating stud sizes to support a buckled panel are obtained. (auth)

26236 (CONF-730942-P3, pp vp Paper H 6/5) HIGH-TEMPERATURE CREEP OF CONCRETE. Gross, H. (Imperial Coll. of Science and Tech., London). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

With the fast development of prestressed concrete pressure vessels for nuclear power stations and the growing concern about the safety of building structures against fire hazards, interest has increased in the knowledge of the behavior of concrete at elevated and high temperatures and its effects on the strain history of loaded structures. Since complex configurations of structures render the partial differential equations of the stress analysis problem insoluble in closed form, techniques for numerical analyses suitable for computer programming are required. The change in the structures' stiffness matrix due to ambient or thermal creep effects is accounted for by the employment of thermal relaxation weighting factors which are arrived at in a rigorous mathematical procedure and valued on the basis of data obtained from experiments performed for thermal creep compliance. The quest for data on thermal creep compliance is set forth. The creep curves obtained are drawn. Linearity in the stress-dependence of the initial thermal strains is observed for low and moderately high temperatures. A formula for the determination of thermoelastic strains is proposed. Values for the ultimate initial and the ultimate creep strains are arrived at. The bandwidth between the domains of safe and failure-procuring test conditions is drawn. A formula is proposed for the reduction of the modulus of elasticity with temperature. Formulas of tri-linear nature are designed for the temperature-dependence of the ultimate stress/cold strength ratio and for the dependence of the ultimate test temperature on the stress/cold strength ratio. The modulus of quasi-thermoelasto-plasticity is introduced. A formula is devised for the temperature-dependence of the ultimate cylinder strength. The applicability of the superposition hypothesis to the overlay of thermal creep strains is proven. The quasi-linearity of the creep rate–time relation in the double logarithmic scale is recognized. A mathematical equation is proposed to fit thermal creep curves. Experimentally substantiated expressions for the temperature and stress-dependence of the pertaining parameters are given. Formulas are proposed for the development of thermal creep strains and thermoviscoelastic strains. A general formula for the determination of linear thermoviscoelastic strains occurring in virgin concrete is arrived at. Using the proposed subprogram CRELAX, normalized thermal creep curves are first transformed to thermal relaxation curves; subsequently, the author's thermal relaxation weighting factors are evaluated. (auth)

26237 (CONF-731212-1) EVALUATION OF THE COMPUTER PROGRAM CREEP–PLAST (CDC VERSION). Hsu, M. B.; Berman, I.; Pai, D. H. (Foster Wheeler Corp., Livingston, N. J. (USA)). 1973. 29p. Dep. NTIS $3.50.

From ASME annual winter meeting; Detroit, Michigan, USA (Dec 1973).

The results of an evaluation of the CREEP–PLAST Program are reported. The assumptions in the formulation of the Program are reviewed. Program operations and user oriented features that were added to the Program are discussed. Selected benchmark problems are then solved and the results are compared with known solutions. (10 references) (auth)

26238 (UCRL-75075(Rev.1)) TOPPING CYCLES AND ADVANCED CONVERSION MACHINERY FOR CENTRAL POWER STATIONS. Mohr, P. B.; Rienecker, F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Dec 1973. 30p. (CONF-731058-1). Dep. NTIS $3.50.

From thermal power conference; Pullman, Washington, USA (3 Oct 1973).

The possibility of developing dynamic conversion machines for topping cycles—expanders and turbines—that might utilize refractory materials not previously applied to this purpose is investigated. A technological basis for topping cycle systems that will extend the conversion efficiency of central power stations to the range of 55 to 60% is provided. The performance of a small (500 cm^3 displacement) graphite helical rotor compressor-expander set operating on inert gas for nearly 300 hr at temperatures up to 1500°C and rotor speeds to 14,000 rpm is described. In a related program, turbine blades and sound monolithic bodies up to 36 in. characteristic dimension were fabricated of the refractory compounds silicon nitride (Si_3N_4) and silicon carbide (SiC), which are compatible with air and combustion products. The application of available materials and power-conversion technology to permit a significant improvement in energy conversion efficiency is discussed. The demonstration of this capability is proposed by devising topping cycle systems incorporating ceramic engines capable of extracting useful energy from combustion heat sources at conditions presently inaccessible. 12 references. (auth)

26239 IMPROVEMENT TO THERMALLY INSULATED PRESSURE VESSELS. (to Technigaz). French Patent 2,158,955. 25 Oct 1972. 10p. (In French).

A heat insulation was developed for pressure vessels. It consists of a porous insulating material retained between a metallic lining and a flexible internal membrane by bolts fixed to both of these parts. Such heat insulation is particularly useful in gas cooled nuclear reactors. (FR)

26240 NUCLEAR REACTOR ARCHITECTURE. Tilliette, Z. (to Commissariat a l'Energie Atomique). French Patent 2,137,095. 13 May 1971. 4p. (In French).

Architecture is presented for nuclear reactors. A special feature is that the prestressed concrete vessel presents a shouldering for the support of the weight bearing structures. This shouldering is positioned between the inner face and the floor of the reactor intended to contain the core. This shouldering can be formed by reducing the diameter of the lower part of the prestressed concrete vessel. The weight bearing structures supported by this shouldering have such a height as to render possible all the intervening operations and dismantling of the components in the vertical cavities from the space beneath. The stability and seismic behavior of the assembly are improved, the volume of concrete corresponding to the lower part of the vessel is reduced together with the cost of the prestressed cables. (FR)

26241 QUALITY CONTROL OF PUMPS FOR NUCLEAR APPLICATIONS. Vockovic, M. ACEC (Ateliers Constr. Elec. Charleroi) Rev.; No. 2, 21-28(1973).

The new generations of primary pumps for nuclear reactors of the PWR (Westinghouse) type have developed rapidly to come to the present day pump sets consisting of a traditional electric motor driving a controlled leakage pump, the ratings continuing to increase. Present control and inspection techniques have followed and even preceded this development. The article reviews the various interventions made by "Quality Control" while the sets are being built, in particular the "Design Review" investigation of the bases of the control chart and that of the testing equipment, together with the various activities of the quality control laboratory, the metrology section, inspection and, finally, the performance tests in the nuclear testing shop, a very complete installation enabling a long-term simulation to be made of the actual operating conditions of the primary motorized pump sets. The article ends with an extract from the "Pumps Quality Control Manual" defining the quality control policy of ACEC-POMPES. (auth)

26242 IMPROVEMENT TO NUCLEAR REACTOR SUPPORTS. Gallo, S. (to Societe Creusot-Loire). French Patent 2,153,177. 23 Sep 1971. 7p. (In French).

Improvements are suggested for reactor supports. Particular emphasis is given to integrated type liquid metal cooled reactors. This support which can be dismantled and reassembled is essentially in the form of a casing. Two horizontal plates form the top and bottom of this casing. These plates are spaced from the core assembly and allow liquid metal coolant to flow through. (FR)

26243 DEMOUNTABLE ASSEMBLY HEAD. Agranier, J. C.; Brard, J. C.; Chalony, A. (to Commissariat a l'Energie Atomique). French Patent 2,138,329. 24 May 1971. 11p. (In French).

A demountable assembly head intended for manipulating nuclear reactor fuel elements and controlling the coolant flow is presented. The gripping head is in the form of a long hollow cylinder provided at its lower end with at least three radial blades and presses against a diaphragm resting on the body of the head which is tube shaped. The body of the head and the gripping head are joined together with a mechanical device enabling the gripping head to be demounted from the body of the head. (FR)

26244 IMPROVEMENTS TO REACTOR SUPPORT GRIDS. (to Societe Babcock-Atlantique). French Patent 2,131,813. 29 Mar 1971. 13p. (In French).

A nuclear reactor grid support is described. It is formed from a lattice network of interlaced girders. Specially shaped bars are positioned at the lattice crossing points, plates being fitted along the lattice axes at positions between these bars. The plates are welded along two of their opposing edges to the specially shaped bars. According to the case considered, the welding faces of these bars and the plates are formed by milling, or the plates are brought into contact along their plane edges with the plane faces formed on the bars, the welding being effected by electron bombardment along the contact planes thus formed. (FR)

26245 IMPROVEMENTS TO NUCLEAR REACTOR CORE HOLDERS. (to Societe Babcock-Atlantique). French Patent 2,134,250. 29 Apr 1971. 14p. (In French).

A procedure is proposed for reducing the number of sequences and the duration of the manufacturing operations and mounting time for reactor core holders, which simultaneously improves the reliability by eliminating the bolts, and in addition conforms to the mechanical and geometrical requirements. The core holder proposed forms a self-supporting assembly (independent of the skirting support) consisting of a vertical vessel open at the top and bottom and vertical plates welded together and following the profile of the outer surface of the reactor core. The reactor vessel is stiffened on its outer surface by horizontal partitions which present an external periphery conforming with the inner surface of the skirting support. Each partition is provided along its outer edge with a flexible part intended for contact with the inner surface of the skirting support. (FR)

26246 USE OF REACTIVITY METERS IN NUCLEAR PLANTS. Gariod, R. (CEN, Grenoble, France); Tournier, E.; Plaige, Y.; Vuong Quan Mai. Ind. At. Spatiales; 17: No. 4, 29-35(Jul 1973). (In French).

The reactivity meters, CMR 66 and CMR 67, have been adopted since 1966 for most European reactors. A recent survey among users of these meters enabled their performance and usefulness to be evaluated. Progress has been made in the field of electronic dividers particularly concerning their stability and switching characteristics for different PAGELS networks. Such progress has led to the possibility of developing in the near future a more specific reactivity meter, and in particular one having a large dynamic range. Source level reactivity meters were also studied, the principal drawback of such meters being the difficulty experienced in obtaining representative flux measurements. The existence of safety reactivity meters operating at the nominal power is also noted. New applications are envisaged such as the reduction of the controlled power or the monitoring of shut-down power reactors. (FR)

26247 METHOD AND INSTALLATION OF HIGH TEMPERATURE INSULATION. Peuchmaur, A. (to Commissariat a l'Energie Atomique). French Patent 2,151,690. 9 Sep 1971. 9p. (In French).

A heat insulation process for a very hot fluid flowing in tubular ducts having nonmachined internal walls is presented. The process is intended to be used at the high temperatures found inside nuclear reactors. It consists of mounting a ceramic ring having a low coefficient of expansion, a high compressive elastic limit, and a small thermal conductivity against the internal surface of a collar having hollow walls and made of nondeformable material. The collar is of such a size as to fit into the tubular duct with a small amount of play. A fluid substance is injected under pressure into the wall of the collar. This fluid substance has the property of becoming solid at the temperature assumed by the duct in service, this temperature being lower than that of the fluid flowing in the duct as a result of the ceramic ring. On solidification a very small retraction occurs such that a stress sufficiently large to retain the ring elements is exerted on the duct and the ceramic ring. An application is presented to the channels connecting the support structure of the reactor core to the exchangers. (FR)

26248 NEUTRON MEASUREMENT SYSTEM IN THE CORE. Savornin, J.; Brecy, J. Technical Meeting No. 10/20. Basel; Nuclex (1972). 6p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

This instrumentation system allows the removal of the miniature fission chamber detectors in the nuclear reactor core in order to measure the neutron flux distribution when the plant is operating. The main characteristic of the equipment carried out by FRAMATOME is a great use and laying out flexibility. (auth)

26249 SPECIFICATIONS, CONSTRUCTION, AND DRIVE OF VALVES FOR SODIUM-COOLED REACTORS. Massengeil, M. Technical Meeting No. 7/17. Basel; Nuclex (1972). 11p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Sodium as a liquid metal places special requirements on the design of the valves and their actuators. The problems which arise and the methods currently used to solve them are described. In particular, the special design of the component parts for use in sodium is discussed. (auth)

26250 IDEAS ON THE SEPARATION OF ELECTRICAL SAFETY CIRCUITS IN NUCLEAR POWER PLANTS. Marti, K. Technical Meeting No. 10/6. Basel; Nuclex (1972). 12p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Requirements on reliability for electrical equipment have become more severe in recent years. Doubling of all safety systems has been followed by stringent separation criteria. Due to the consideration of faults within a large area it became necessary to include ever increasing portions of the plant into the safety investigations. (auth)

26251 FAST RESPONSE FLUX MAPPING SYSTEM USING SELF-POWERED NEUTRON DETECTORS. Johnstone, W. (Atomic Energy Research Establishment, Harwell, Eng.); Mobbs, D. J.; Wallace, G. R. Technical Meeting No. 10/15. Basel; Nuclex (1972). 14p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

An inverse function amplifier is used to predict the final value of the slowly changing current from a self powered neutron detector and to provide a fast response system. Two experimental rigs are described which are controlled using this equipment. Some suggestions for flux mapping in water reactors are made. 6 references. (auth)

26252 CONTRIBUTION OF REACTIMETERS TO THE OPTIMIZATION OF THE CONTROL AND OPERATION OF REACTORS. Mai Vuong, Q. Technical Meeting No. 10/16. Basel; Nuclex (1972). 13p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The term "reactivity" defines a value that is used to evaluate some characteristics of the elements constituting the reactor. In this aspect, its determination is absolutely necessary for reactor physicists. The value of reactivity is often deduced from the value of the period measured by the specific Nordheim curve of the reactor involved. This equivalence however is valid only for the asymptotic values of the period, as the transmit deviations can be very substantial. Each measurement, followed by a determination on a graph, takes a non-negligible time. Two main applications can be distinguished: allowing the measurement of antireactivity under sub-critical operating conditions or for the first start-up of a nuclear power-station; and allowing the estimation of the subcritical fuel-charging level or, in the power range, the detection of small changes of reactivity of accidental origin that are not detected by conventional measurements. (auth)

26253 RADIOISOTOPIC NEUTRON SOURCES FOR REACTOR INSTRUMENTATION. Ainsworth, A.; Hall, E. G. Technical Meeting No. 10/18. Basel; Nuclex (1972). 16p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The factors influencing the choice and design of neutron sources for reactor instrumentation are discussed. The effects of neutron irradiation on half life, heating, gas production, neutron and gamma emission of radioisotopic neutron sources must be taken into account. 7 references. (auth)

26254 POWER INCREASE OF NUCLEAR POWER PLANT BY PEAK LOAD TURBINES AND STEAM STORAGE INSTALLATION. Beckmann, G.; Gilli, P. V. Technical Meeting No. 6/9. Basel; Nuclex (1972). 20p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Nuclear power with its environmental advantages may be employed for peak load coverage by means of energy storage. Compared to conventional peak load generation, a plant with steam storage, superheat accumulators and separate multiflow peak load turbine shows pronounced economic advantages. 9 references. (auth)

26255 REACTION-PROTECTED STEAM GENERATOR FOR SODIUM-COOLED REACTOR INSTALLATIONS. Ratzel, W. Technical Meeting No. 7/5. Basel; Nuclex (1972). 11p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The primary sodium heated, reaction-proof steam generator would allow the elimination of the secondary intermediate sodium system which is normally used for sodium cooled power reactors. The main design element of the steam generator is the triple wall tube (steel-copper-steel). The test of a 3 MW(t) prototype steam generator was found to be satisfactory. Principal studies on the design of a large nuclear power plant with reaction-proof steam generators were performed. (auth)

26256 CHARACTERISTICS OF ELECTROMAGNETIC PUMPS. Werner, R. C. Technical Meeting No. 7/6. Basel; Nuclex (1972) 7p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Differences and similarities of electromagnetic pumps and electric motors are described. Performance considerations for electromagnetic pumps are analyzed. Safety and reliability features of the pumps are discussed. (auth)

26257 IMPROVEMENT OF THE DESIGN OF DRYERS-RESUPERHEATERS FOR NUCLEAR POWER PLANTS. Tillequin, J. Technical Meeting No. 6/5. Basel; Nuclex (1972). 16p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

26258 TECHNOLOGY OF PRESTRESSED DEVELOPMENT OF PRESSURE AND PROTECTION VESSELS WITH REFERENCE TO THE NEWLY DEVELOPED SYSTEM OF THE BBRV-PRESTRESSING TECHNIQUE. Speck, F. E. Technical Meeting No. 3/8. Basel; Nuclex (1972). 11p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Prestressed concrete pressure vessels, mostly of cylindrical shape, are commonly realized with a vertical and a horizontal prestress. This latter may consist of single tendons or of wound bands. The main characteristics of such horizontal winding, the more important specifications and the problems, which will be met in practice, are described. A short presentation of the newly developed SW 8500-System is included. (auth)

26259 NUCLEAR FAILED FUEL DETECTION SYSTEM. Weiss, H. H.; Johnson, R. J. (to Westinghouse Electric Corp.). US Patent 3,786,257. 15 Jan 1974. Filed date 12 Aug 1971. 10p.

A system is disclosed which utilizes multiple radiation detectors to establish the isotopic or pseudoisotopic (weighted average of several isotopes) content of radiation sources on a continuous on-line basis. A specific application which utilizes this principle is a failed fuel monitor which continuously monitors the delayed neutron and gamma activity emanating from the primary coolant of a nuclear reactor. Employing two neutron detectors, the system has the ability to distinguish between activity from failed fuel and from fuel rod surface contamination. Applying a technique to compensate for activity build-up in the primary coolant loop, the system makes it possible to interpret the signals even during power transients. The provision of a third detector responsive to the gamma radiation emitted from the primary coolant in the reactor coolant loop enables the system to distinguish between enlarged cladding failures in already failed fuel rods and additional fuel failures. (Official Gazette)

26260 APPLICATION OF PROGRAMMED TEST METHOD TO NUCLEAR PRESSURE VESSEL MATERIALS. Suskida, H.; Ando, T. Technical Meeting No. 1/9. Basel; Nuclex (1972). 25p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

A review is presented of the programmed test method for verifying the mechanical properties of heavy thickness steel plates for nuclear pressure vessels by using small specimens. (auth)

26261 ADVANTAGES OF ELECTRON WELDING IN THE FABRICATION AND DESIGN OF REACTOR INTERNAL STRUCTURES. Thome, P. Technical Meeting No. 1/15. Basel; Nuclex (1972). 12p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

No-distortion electron-beam welding can now be applied to large size thick walled parts. Significant economy could be realized by replacing conventional methods of welding and subsequent machining by E. B. welding. This method allows designing assemblies while eliminating practically all bolts in the core internals. Development of original devices in the general design can be achieved through this process. (auth)

26262 E.D.F.-C.E.A.-S.E.C.N. RESEARCH AND DEVELOPMENT PROGRAM FOR PRESTRESSED CONCRETE PRESSURE VESSELS. Lacroix, R. Technical Meeting No. 2/5. Basel; Nuclex (1972). 12p. (In French, German, and English).

From international nuclear industries fair; Basel; Switzerland (16 Oct 1972).

The "E.D.F.," the French "C.E.A." and four civil engineering companies gathered in the "Société d'Etude des Caissons Nucléaires" have been involved since 1969 in a program of research and development on prestressed concrete vessels. A program of fundamental research (concrete performance of calculation codes, theoretical studies of the heat insulators, exploitation of measures on existing vessels) and of studies of the main components (performance of an original process for insulating i.e., the hot-skin-studies on a more classical heat insulation, particularly for the H.T.R.-moveable shutters) has been completed. The results thus obtained allow one to draw encouraging prospects for the building of prestressed concrete vessels for the light water process. (auth)

26263 MODERN MEASUREMENT SYSTEMS FOR OUTGAS MONITORING OF NUCLEAR POWER PLANTS. Maushart, R. Technical meeting No. 9/18. Basel; Nuclex (1972). 10p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The measurement of the exhaust air activities from nuclear power plants not only serves for the observance of the approved discharge values, but it also serves for the discharge balancing of the single nuclides or nuclide groups. Hence demands on the measuring instruments are derived, and modern systems for the detection of noblegas, aerosol, iodine, and tritium activities are described. (auth)

26264 DRY REFRIGERATION LOOPS FOR NUCLEAR POWER PLANTS. Di Pace, D. Technical Meeting No. 9/27. Basel; Nuclex (1972). 23p. (In French).

From international nuclear industries fair; Basel; Switzerland (16 Oct 1972).

A new condensation system called "the dry cooling tower system" is described. The dry cooling towers are available now. They are mainly comprised of a direct contact condenser in which the steam from the turbine is condensed as it comes into contact with sprayed water, and an air-cooled heat exchanger in which the condensed water is cooled before being recycled in the direct contact condenser. (auth)

26265 ENVIRONMENTAL PROTECTION THROUGH AIR COOLING. Forgo, L. Technical Meeting No. 9/26. Basel; Nuclex (1972). 14p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

26266 COOLING TOWERS AND EFFLUENT TREATMENT: THE ENVIRONMENTAL CONSIDERATIONS. Hartley, B. Technical Meeting No. 9/24. Basel; Nuclex (1972). 14p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

26267 COOLING TOWER IN NUCLEAR PLANT PROCESSES. Henning, H. Technical Meeting No. 9/23. Basel; Nuclex (1972). 25p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Cooling tower operation with a view to the environmental protection problems of noise pollution, water entrainment, plume condensation, and recirculation is discussed. The technical and physical aspects of cooling tower design with a view to official regulations restricting heat pollution of natural water sources are pointed out. (auth)

26268 ULTRASONIC DEVICE FOR REPEATED TESTINGS ON REACTOR PRESSURE VESSELS. Meyer, H. J.; Rath, W. Technical Meeting No. 9/21. Basel; Nuclex (1972). 21p. (In German).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

By the use of remote-controlled ultrasonic testing equipment in combination with the facilities of modern data logging and processing it is possible to carry out periodic in-service inspections of reactor pressure vessels. Further development is necessary to meet all requirements and to overcome existing problems. 8 references. (auth)

26269 NORMY RASCHETA NA PROCHNOST' ELEMENTOV REAKTOROV PAROGENERATOROV, SOSUDOV I TRUBOPROVODOV ATOMNYKH ELEKTROSTANTSII OPYTNYKH I ISSLEDOVATEL'SKIKH YADERNYKH REAKTOROV I USTANOVOK. (Standards for the Calculation of the Stability of Reactor Elements, Steam Generators, Vessels, and Piping of Atomic Power Stations, Test and Research Reactors, and Installations). Tsesarskaya, L. M. (ed.). Moscow; Metallurgiya (1973). 408p.

Theoretical and experimental studies on the stability of reactor vessels, steam generators, piping, experimental channels, and other instrumentation are compiled. The experience gained in the design, construction, and operation of these components is considered. Methods are recommended for the determination of the stress and displacement of structural elements and for the determination of the mechanical properties of the materials. (tr-auth)

26270 USE OF A HYDROPHYLIC NETWORK-TYPE POLYMER FOR NEUTRON SHIELDING. Coats, W. E. Technical Meeting No. 9/22. Basel; Nuclex (1972). 16p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The properties and applications of "gelled water" for neutron shielding are presented. The comparison of Opti/Gel and Aqua/Gel is included. 10 references. (DCC)

Reactor Fuels

Refer also to abstracts 24585–24587, 24590, 24592–24595, 24597–24601, 24608, 24640, 24669, 24672, 24673, 24707, 24708, and 24860.

26271 IN-PILE THERMAL CONDUCTIVITY OF FUEL OXIDE: UO_2 PELLETS AND VIPAC UO_2-PuO_2 PELLETS AND SOL-GEL. Calza-Bini, A.; Cosoli, G.; Filacchioni, G.; Lanchi, M.; Nobili, A.; Rocca, U.; Rotoloni, P. L. (CNEN, Rome). Nucl. Technol.; 21: No. 3, 208-216(Mar 1974).

Irradiation experiments carried out by the Comitato Nazionale Energia Nucleare to evaluate the thermal behavior of different types of fuel are described. The integral thermal conductivity has been measured continuously during the irradiation. The fuel temperatures have been detected by thermocouples, and total power has been measured by a calorimetric system able to detect separately the nuclear and gamma-ray power. The integral thermal conductivity curve versus temperature has been found for the UO_2 pelletized and vibrocompacted (Vipac) powder and for the UO_2-PuO_2 pelletized and Sphere Pac sol-gel; the accuracy is between 10 and 12%. Differences have been found, for all materials tested, between the data at the first startup and the data measured during the following life; the differences between Vipac and pelletized samples decrease after the first startup because of the restructuring of the material. 10 references. (auth)

26272 METHOD AND EQUIPMENT FOR RECORDING IN BINARY CODE AND FOR READING AN IDENTIFICATION NUMBER ON A METALLIC PART. Samoel, A. (to Commissariat a l'Energie Atomique). French Patent 2,148,859. 6 Aug 1971. 12p. (In French).

A procedure is presented for labeling small identical metallic parts (fuel element can tubes) using binary code. It consists of directing microassembling jets at various positions on the parts to be identified, each of these jets corresponding (in binary code) to one of the figures of the number to be written. Before its incidence on the metallic part, each jet is deviated depending upon whether it corresponds to the figure 1 or 0. The part having been microassembled in this way is then read (the microassembling jets are parallel and equidistant). The reading operation consists of projecting a light beam onto the part, the distribution of the light of this beam being identical to that of the microassembling jet. The part is illuminated with nonnormal light in such a way that every position of the part affected by the microassemblage is illuminated by one of the light beams. The beams reflected by the part are then analyzed using a reading logic system having a controllable triggering threshold. The equipment used is presented. (FR)

26273 GERMAN IMPORTS AND EXPORTS OF NUCLEAR FUELS IN 1972. Atomwirt., Atomtech.; 18: No. 12, 568-569 (Dec 1973). (In German).

The exports and imports of U-235, enriched uranium, depleted uranium, natural uranium, plutonium, and thorium in the German Federal Republic in 1972 are discussed. Data are tabulated for the nuclear fuels. (MCW)

26274 USE OF A LASER BEAM FOR THE DISMANTLING OF FUEL ASSEMBLIES. Martin, J.; Bernard, J. Technical Meeting No. 7/18. Basel; Nuclex (1972). 18p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

A new method for stripping fuel assemblies by laser beam has been developed. Once the principal parameters involved have been described, several tests are presented to assess their effect and to determine the possible performances. The advantages of such a method are numerous compared to the conventional process, and relate to machine design as well as to operation flexibility, reliability or less contamination hazards. (auth)

26275 FAST AND ACCURATE NON-DESTRUCTIVE TESTING BENCH FOR INSPECTION OF CANNING TUBES. Gundtoft, H. E. (Danish Atomic Energy Commission Research Establishment, Risoe); Nielsen, N. Technical Meeting No. 5/18. Basel; Nuclex (1972). 16p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The development is described of an inspection bench for nondestructive examination of canning tubes. The bench is revolutionary in that the internal diameter is calculated from exact measurement of the outer diameter and the wall thickness. The transducers for inspection and control are rotated around the tube. Thus all measurements are made externally to the tube. The results of these innovations is that non-destructive examination can be made in a single pass of the tube, and the assessment is more accurate, economical, and faster than that possible with existing technique. (auth)

26276 IN-REACTOR BEHAVIOR AND PROPERTIES OF ZIRCALOY CLADDING TUBES. Aas, S.; Rose, R. Technical Meeting No. 5/17. Basel; Nuclex (1972). 14p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Some in-reactor defects in Zircaloy are described. The relation of these defects to fuel rod design, manufacturing and operational aspects is analyzed. Local hydriding on the inside of the cladding is caused by moisture released from the fuel. It is accelerated by certain chemical species like fluorides. Pickling of the inside of the tube is not permitted therefore. Sandblasting seems to be the best surface treatment. Drying of the UO_2 is essential. The cladding interacts mechanically with the UO_2. The cladding is strained and sometimes to fracture. A smooth cladding surface with no flaws is preferable. Ovality and eccentricity must be avoided. A texture with radial basal poles gives the best combination of mechanical properties. The gap between clad and fuel should be generous. Iodine released from the fuel may induce stress corrosion cracking in the cladding. Slow increases in power seem advisable. Excessive corrosion of the Zircaloys is rare. Defects have developed with heavy and tight deposits of crud, also when a nitrogen-contaminated atmosphere is present during welding. Autoclaving at 400°C does not reveal nitrogen-contamination. Fretting corrosion may occur if the springforce between spacer and cladding is too low. Finally the advantages of using anodic oxidation to produce an oxide film on the cladding are briefly reviewed. 18 references. (auth)

Reactor Control Systems

Refer also to abstracts 24595, 26042, 26043, 26160, and 26169.

26277 (CEA-CONF-2175) PRINCIPLES AND INSTRUMENTATION FOR THE CONTROL OF FRENCH REACTORS. Furet, J.; Weill, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). 2 Mar 1973. 35p. (In French). (CONF-730983-3). Dep. NTIS (U. S. Sales Only) $3.75.

From Congress of the Society of Electrical Electronic and Radio Engineers meeting; Vittel, France (11 Sep 1973).

The principles and instrumentation for the control of French reactors are actually the result of collaboration among the CEA, industry, and the EDF. This collaboration and the principles which have influenced the conception and the availability of the material are described. The problems of safety, availability, reliability, maintenance, and economy and the compromises among these criteria are treated. A description of the most advanced detectors and the associated electronic instrumentation both for the neutron control and for the detection of cladding ruptures is given. An analysis is given of automatic devices and the use of computers, particularly small computers for a determined function. 9 references. (tr-auth)

26278 PRACTICAL XENON SPATIAL CONTROL. Bauer, D. C. (Bettis Atomic Power Lab., West Mifflin, PA); Poncelet, C. G. Nucl. Technol.; 21: No. 3, 165-189(Mar 1974).

Several more efficient and effective xenon spatial control procedures have been developed through simulation research at Carnegie-Mellon University and verification on an operating commercial pressurized water reactor at the Point Beach Plant in Two Rivers, Wisconsin. The developed spatial control procedures have taken the role of the human operator into realistic account. First Overtone Control provides an efficient and effective approach with an accommodatable, if stiff, premium on the timeliness of intervention. Overstressed Direct Offset Control (DOC) improves the efficiency of Simple DOC, the current procedure, by managing a trade-off between spatial xenon and iodine effects throughout a shorter control period. Collectively, the alternative control approaches focus attention on causes rather than symptoms (i.e., xenon and iodine spatial redistribution by flux) and highlight the importance of early action to restore iodine equilibration. The spatial control procedures were reliably executed by the Point Beach operators normally assigned to a watch. They demonstrated the capability necessary to exercise whatever judgments were called for in the timing and control-rod insertions and retractions needed. The future growth of nuclear power plants into more complex loading patterns that will induce spatial flux oscillations (particularly later in life) suggests that the premium on efficient and effective control procedures for xenon spatial effects will increase. 54 references. (auth)

26279 SAFETY AND CONTROL STUDIES OF A BOILING WATER REACTOR PLANT, USING A REAL TIME SIMULATOR. Josefsson, R. (Aktiebolaget Atomenergi, Studsvik, Sweden); Schuch, N.; Spanne, T. Technical Meeting No. 10/14. Basel; Nuclex (1972). 14p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The mathematical model presented simulates the dynamics of the main components of a BWR power plant in real time. The model of the reactor core is one-dimensional. The other components are described by lumped parameter models. The model is programmed for a hybrid computer, and is currently used for safety and control studies of a power plant under construction. (auth)

26280 HIGH SECURITY COMPUTER SYSTEM FOR NUCLEAR POWER PLANT MONITORING AND CONTROL. Shirra, J. M.; Bull, M. G. Technical Meeting No. 10/17. Basel; Nuclex (1972). 14p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The problems concerned with the design, testing and commissioning of a high-availability computer control system are described. Particular reference is made to the system installed at Hinkley Point ''B'' Power Station now in an advanced stage of commissioning by the Nuclear Power Group for the CEGB. A description of the software to perform the automatic fault detection and correction functions is provided. An analysis of the component failures during the first year of operation of the first part of the system is presented. (auth)

26281 INSTRUMENTATION AND CONTROL OF BWR PLANTS IN JAPAN. Nomura, A. (Tokyo Electric Power Co., Inc.); Forster, J.; Ryan, R. C. Technical Meeting No. 10/4. Basel; Nuclex (1972). 31p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The nuclear instrumentation and control systems, through their performance, have contributed to the safe and efficient operation of the boiling water reactor power plants in Japan. The operating experience of Fukushima I and Tsuruga is presented, a general design philosophy given, and specific control and monitoring systems described. Automatic and operator-controlled functions are discussed. (auth)

26282 EFFECTS OF INCORE DETECTORS ON WATER REACTOR FUEL MANAGEMENT. Foreman, C. E.; Morgan, W. R.; Neissel, J. P.; Parkos, G. R. Technical Meeting No. 10/5. Basel; Nuclex (1972). 19p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Safe and efficient utilization of nuclear fuel in boiling water reactors is achieved by designed and innovative uses of power range incore neutron detectors. Operating experience has demonstrated that the incore detectors are satisfactory and highly reliable components. Their use has led to increased efficiencies in operations management which has influenced fuel management. The detectors are a vital input to online computers, used by utilities for performance calculations, data logging and core management functions. Future trends expected include improving detector lifetime and reliability and utilization of remote central process computers. (auth)

26283 PFR STATION CONTROL SYSTEM. Mummery, P. W.; Evans, A. D.; Barclay, F. J. (United Kingdom Atomic Energy Authority, Dounreay, Scotland). Technical Meeting No. 10/7. Basel; Nuclex (1972). 10p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The control system of PFR is no different in principle to that of any other nuclear power station although the data display and data reduction system is relatively novel. It is similar to that being provided for other nuclear stations currently under construction. Attention is drawn to those aspects of the control and instrumentation system which have novel features arising from the liquid metal environment or from other specific requirements of fast reactors. (auth)

26284 COMPUTER CONTROL IN THE PICKERING NUCLEAR POWER STATION. Mahood, T. B. Technical Meeting No. 10/8. Basel; Nuclex (1972). 19p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

Dual digital computer control systems have been provided for the four unit 2000 megawatt Pickering Nuclear Generating Station. Direct digital control has been provided for the complete reactor control system, as well as a large number of other tasks, without any backup automatic analog control systems. The highly successful experience with three operating units over a total operating time of three years is discussed. (auth)

26285 ROLE OF A COMPUTER IN THE OPERATION OF A PRESSURIZED WATER REACTOR (PWR). Nicol, G. Technical Meeting No. 10/10. Basel; Nuclex (1972). 15p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

26286 ADVANCED CONTROL AND AUTOMATION OF NUCLEAR POWER PLANTS. Lunde, J. E. (Institutt for Atomenergi, Halden, Norway). Technical Meeting No. 10/11. Basel; Nuclex (1972). 23p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

A review is given of the current trends in the development of automated systems for control and supervision of nuclear power stations, with the main attention on the increasing role of process computers. Modular computer systems now being developed are described. The functional role of a process computer system in a nuclear plant is discussed with reference to a suggested quantitative method that can be used for evaluation of alternative computer structures. The advantages to be gained by introducing computerized protection systems are outlined. Several operational and economical advantages can be gained by the introduction of a computerbased control room with extensive utilization of color display units and operator's consoles. However, problems exist in relation to an appropriate organization of the information that should be presented to the plant operator. The incentives for applying direct digital plant control and an outline of the particular features of modern control methods in relation to nuclear power plant control are included. The introduction of core power distribution control systems holds considerable potential for improved operations management and fuel cycle performance. A method, based on the modern control approach and already experimentally tested, is described. 35 references. (auth)

26287 INTEGRATED CONTROL ROOM SYSTEM FOR A NUCLEAR POWER PLANT. Milam, W. G.; Minor, G. C. Technical Meeting No. 10/12. Basel; Nuclex (1972). 12p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The control systems/operator interface and plant instrumentation system interconnections have increased markedly in the last decade. While plant ratings have increased from 200 MW(e) to 1200 MW(e), control board lengths have grown from 40 feet to 60 feet, and control wires entering the control room have more than doubled. The increased scope of control equipment affects both the construction schedule and the operator interface. The larger quantity of control equipment increases and complicates the construction schedule of the plant. In todays nuclear power plants, the operator is faced with more systems, with more data per system, and because of the larger plant rating, more serious consequences resulting from misoperation. Integration of control system equipment, operator displays, and control room rearrangement offers many advantages which help alleviate the difficulties arising from increased plant size. Integration of equipment functions reduces intracontrol room cabling and provides a readily accessible interface for field wiring. The control room arrangement philosophy of the integrated approach directs the assemblage of controls used during normal operation into one operating console or benchboard. Other controls are grouped and set aside from the normal operation but conveniently available for operator action. The instrumentation for each plant system includes annunciation, cathode ray tube displays, selected hardwired indications and control elements. Subloop sequencing is utilized where it can be done so prudently. A major component of the operator interface is the data acquisition and the associated cathode ray tube display system. This system is a computer based system which uses the principle of distributed intelligence. The distributed intelligence system provides flexibility and ease of expansion. The integrated control room concept employs modular floor sections for the factory mounting of control room equipment. Modular floor sections allow interpanel connections to be made in the factory and facilitates the site installation of the control room equipment. Factory interconnection of control room panels provides for factory system testing in addition to the customary panel component tasks. (auth)

26288 DEVELOPMENT OF REACTIVITY CONTROL SYSTEMS FOR GAS-COOLED REACTORS. McPhie, J. M. Technical Meeting No. 10/1. Basel; Nuclex (1972). 21p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The design and development of control rod systems for five successive power stations in the U. K. including the latest Mark II AGR stations at Hartlepool and Heysham are described. (auth)

26289 EVOLUTION AND PRESENT STATUS OF THE CONTROL OF NUCLEAR REACTORS. Arnaud, R. Technical Meeting No. 10/2. Basel; Nuclex (1972). 13p. (In French).

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The principles from which the present French nuclear instrumentation originated are described. The progress made in the fields of performances, economy and easy application (performance of sets associated with pulse detectors without preamplifiers, linear and logarithmic sets, fluctuation sets, etc. . . .) is reviewed. The adaptation necessary to make the instrumentation suited to the recent French program relative to the construction of nuclear power-stations is discussed. (auth)

26290 EMERGENCY SHUT-DOWN SYSTEM FOR ADVANCED GAS COOLED REACTOR. Dobson, D. E. Technical Meeting No. 9/16. Basel; Nuclex (1972). 6p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

After construction of Hartlepool Nuclear Power Station had begun late in 1968, BNDC were requested to include a back-up system in addition to the normal top-entry control rod system. The system was required to provide protection in the event of any fault, or damage, which could be postulated and which would potentially prevent insertion of a sufficient number of control rods to shut-down the reactor. After considering several novel systems it was decided early in 1970 to adopt a quick acting secondary shut-down (S.S.D.) system in which gaseous nitrogen is injected directly into 165 unsealed interstitial channels in the reactor graphite core via a system of distribution pipework. To overcome the need to keep a damaged reactor pressurized with nitrogen to hold it permanently shut-down a tertiary shut-down (T.S.D.) system is also incorporated. The TSD system employs solid neutron absorbing beads which are pneumatically conveyed into selected SSD core channels. It is a slow acting system and its initiation is dependent upon administrative and manual procedures. (auth)

26291 FUNCTIONS OF PROCESS CONTROL COMPUTERS WITHIN THE OPERATION MONITORING SYSTEM OF PWRs. Bock, H. W. (Kraftwerk Union AG, Erlangen, Ger.); Sengler, G.; Zimmermann, M.; Zaiss, H. W. Siemens-Z.; 47: No. 11, 770-774(Nov 1973). (In German).

Quick and accurate, reliable information on the nuclear and thermodynamic conditions in a nuclear power plant offers the possibility of optimizing reactor operation with regard to reactor safety and economy. Due to the great number of measured data, this can only be done by using process control computers. A special programme has been developed for the recording, evaluation, control and print-out or display of data of the monitoring system of pressurized light-water reactors. (GE)

26292 PROCESS CONTROL COMPUTERS IN NUCLEAR POWER PLANTS WITH PRESSURIZED WATER REACTORS. Graf, G. (Kraftwerk Union AG, Erlangen, Ger.); Haehle, E. Siemens-Z.; 47: No. 11, 763-774(Nov 1973). (In German).

Process control computers are the most important element of the monitoring system of nuclear power plants with pressurized water reactors. They provide the operating personnel with the information required for the detection and handling of malfunctions and for choosing appropriate modes of operation. Process control computers are predominantly used to increase the availability of the overall plant. The information available to the personnel—above all in the reactor building itself—is essentially based on data that can only be obtained by means of process control computers. The approved standardized systems that are used for this purpose in present PWR-type reactors are described. (GE)

26293 CONTROL ROD DRIVE SYSTEM FOR A HIGH TEMPERATURE GAS-COOLED REACTOR. Ledin, E. (Gulf General Atomic Co., San Diego, CA). Nucl. Eng. Des.; 26: No. 1, 158-169 (1974).

The first commercial application of a high temperature gas-cooled reactor presented some rather unique functional and material requirements for the control rod system mechanical components. Reactor core geometry and coolant temperature distribution required the control rod drives to be located below the reactor vessel and to operate against gravity for shutting down the reactor. High temperature, high radiation, and the characteristic inertness of the helium coolant imposed operating conditions on materials and lubricants for which little or no previous operating and test experience existed. The philosophy behind the design, a description of the equipment and its operation, and a description of the research and development program are presented. Since this equipment has been exposed to both low- and full-power reactor operation, the experience encountered in these areas is reviewed. Significantly useful information was derived in the area of material combinations and component lubrication under unusual environmental conditions. The application of a hydraulic motor as the motive power source for the control rods resulted in the development of a unique and reliable mechanism for automatically decelerating a high velocity shaft rotation at a fixed limit of revolutions. (auth)

Nuclear Power Plant Economics

Refer also to abstracts 25999, 26079, and 26254.

26294 (NP-19950) MARKET SURVEY FOR NUCLEAR POWER IN DEVELOPING COUNTRIES. General Report. (International Atomic Energy Agency, Vienna (Austria)). Sep 1973. 253p. IAEA $15.00.

A market survey was performed to determine the size and timing of demand for nuclear power plants in selected developing countries where they might play an economic role in complementing conventional energy sources. The scope and implementation of the survey are described and the results are presented. (JWR)

26295 (WASH-1298) EVALUATION OF NUCLEAR POWER PLANT AVAILABILITY. Wilson, T. R.; Hildreth, M. S. Jr.; Gower, G. C. (USAEC Office of Operations Evaluation, Washington, D.C.). Jan 1974. 62p. Dep. NTIS $5.25.

A study was made of nuclear and fossil power plant operating experience to compare plant availability and to determine the cause and safety significance of plant outages for nuclear plants. The availability of the nuclear power plants is lower than the general design objective during the first one to three years of commercial service. Following this period of operation, however, average availability has approached or exceeded 80%. The average availability of nuclear plants has been nearly the same as fossil plants of approximately the same size during the twelve year period 1960 to 1971. Approximately half of the forced outages of nuclear plants has resulted from events that are considered to have safety significance. In no case, however, was there any injury to a member of the public or a release of radioactive materials in excess of permissible levels. (auth)

26296 INFORMATION TO BE INCLUDED IN A TENDER CALL. Aikin, A. M. (Atomic Energy of Canada Ltd., Ottawa). pp 99-113 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

Some data are presented concerning the information which should be included in a tender call. To obtain satisfactory bids, the tender call must contain the information needed by the potential suppliers to prepare their tenders properly and accurately. Naturally there should be no ambiguities concerning the performance specifications and supplier's scope of supply and responsibility; but there is much more information that should be given to guide the bidder in selecting the best total package to meet the buyer's needs. Some of these areas are discussed. (INIS)

26297 INVITING COMPETING BIDS: UTILITIES EXPERIENCE IN JAPAN. Fujii, T. pp 57-80 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

Information on nuclear power plant bid competition is presented concerning fundamental consideration for bid invitation, how to organize bid invitation documents, how to prepare bid invitation documents, and several comments from experience. (INIS)

26298 SPECIAL FEATURES OF NUCLEAR PLANTS AS COMPARED TO CONVENTIONAL PLANTS. Davis, W. K. (Bechtel Corp., San Francisco). pp 285-306 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

Some of the major management considerations involved in establishing a nuclear power program as compared with the management factors involved in a fossil-fired power plant or a hydroelectric plant are presented. (INIS)

26299 PLANNING, EVALUATION, AND SELECTION OF NUCLEAR POWER PLANTS. Baron, S. (Burns and Roe, Inc., Oradell, NJ). pp 121-150 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

Some problems in connection with the planning, evaluation and selection of nuclear power plants are described. Some information is presented concerning call for bids, bid evaluations, balance of plant cost and other cost factors and fuel offering. (INIS)

26300 PREPARATORY STEPS BEFORE INVITING BIDS FOR NUCLEAR POWER PLANTS IN DEVELOPING COUNTRIES. Khan, M. A. (International Atomic Energy Agency, Vienna). pp 1-12 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

A great amount of preparatory work must precede the actual invitation to bid on a nuclear plant. Unless the customer has carefully attended to all the essential preliminary steps and the country has prepared itself for the introduction of nuclear power, the project will not materialize. As far as the basic preparatory steps are concerned, these may take a normal utility at least two years. The preparation of a long range nuclear program and the setting up of regulatory framework would require even longer as it involves several government bodies and legislaure. (INIS)

26301 SPECIAL CONSIDERATIONS IN CONSTRUCTION OF NUCLEAR POWER PLANTS IN DEVELOPING COUNTRIES. Polliart, A. J. (CEN de Saclay, Gif-sur-Yvette, France). pp 269-284 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

Some information is presented in connection with the construction of nuclear power plants in developing countries. Some considerations regarding the contract; problems of management; technical problems before site construction; and problems during site works of a nuclear power plant are discussed. (INIS)

26302 ORGANIZING NUCLEAR POWER PROJECTS IN A DEVELOPING COUNTRY. Surya Rao, V. (Dept. of Atomic Energy, Bombay). pp 13-55 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

Diversities in the indigenous situations among various countries in South Asia and Far East are discussed. Merit of considering unique experiences of one developing country are established. Development of nuclear program in India is traced. Advantages and essentiality of an integrated approach to the nuclear power program is explained and such an approach inherent in India's program highlighted. Working set up for implementing nuclear programs in India and its workability is discussed. Organization of Power Projects Engineering Division and the special tasks of constituent units, with special emphasis on the vital role of quality surveillance during manufacture and methods employed, are discussed. (auth)

26303 TECHNICAL EVALUATION OF BIDS. Stobbs, J. J. (Electro-Watt Engineering Services Ltd., Zurich). pp 81-97 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

The technical evaluation of bids from the point of view of the utility is presented. The evaluation activities have been grouped as follows: evaluation of the information supplied; evaluation of the overall scope of supply and supply limits; detailed evaluation of components and systems; evaluation of the overall performance of the station; and evaluation of overall layout and the arrangement of equipment. (INIS)

26304 INDIAN EXPERIENCE IN THE CONSTRUCTION, MANAGEMENT OF NUCLEAR POWER PROJECTS. Surya Rao, V. (Dept. of Atomic Energy, Bombay). pp 235-267 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

Responsibilities of project divisions as distinct units of power projects engineering division are defined. Special features of various functions and project division's approach to these functions is explained. Importance of good housekeeping and quality control and inspection and methods are discussed. Installation co-ordination, commissioning programme and recruitment and training of skilled personnel are explained. (auth)

26305 BIDDING PROCESS: A DESIGNER AND CONSTRUCTORS VIEWPOINT. Joss, J. O. (Nuclear Power Group Ltd., Knutsford, Eng.). pp 115-119 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

The bidding process from a designer and constructors viewpoint is described. The bid for a nuclear power plant project in a foreign country can be a long and expensive undertaking—exactly how long and how expensive depends on the requirements of the purchaser as set out in his specification. It is not therefore an undertaking to be entered into lightly and the specification is examined as closely and with as much care by prospective bidder as are the received bids at a later stage by the prospective purchaser. (INIS)

26306 INFLUENCE OF FINANCING TERMS AND LOAN ARRANGEMENTS. Krymm, R.; Roberts, J. T. (International Atomic Energy Agency, Vienna). pp 161-171 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

The crucial practical importance of financing terms in the comparison of power projects is analyzed. Whenever loans are granted for a particular project at rates substantially below the present worth discount rate applicable to the country an element of rebate is introduced. Formulae for the quantitative assessment of these rebates are presented. A diagram which permits a quick estimate of the discounts inherent in different financing plans is included. (auth)

26307 CONSIDERATIONS IN THE EVALUATION OF NUCLEAR STEAM PLANT PROPOSALS. Aikin, A. M. (Atomic Energy of Canada Ltd., Ottawa). pp 151-159 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

Some considerations are discussed in the evaluation of nuclear steam plant proposals. These considerations refer to the following: technical matters, economics, cost and financing, expected system needs and future requirements, safety, training and political factors. (INIS)

26308 NUCLEAR POWER: TAMED AND MATURE FOR A PLACE IN OUR ENERGY SUPPLY. Haga, I. (Norges Vassdrags-of Elektrisitetsvesen, Oslo), Wethe, P. I. Tek. Ukebl.; 121: No. 3, 10-16(17 Jan 1974).

The cost structure of electric power from a nuclear power plant is briefly explained. The fuel cycle is then outlined and its influence on fuel costs stated. The form and distribution of the radioactive wastes is then discussed, and possible methods of disposal described. The emergency cooling requirements are explained and finally the hazards following a reactor accident are briefly evaluated. (NO)

26309 NUCLEAR POWER IN THE WORLD ECONOMY. Hveding, V. (Norges Vassdrags-og Elektrisitetsvesen, Oslo). Tek. Ukebl.; 120: No. 48, 4-5(22 Nov 1973).

Following a historical survey of the background of nuclear power, its position in the world perspective today and in the near future is briefly stated. While Norway, with reserves of oil and natural gas to supplement the diminishing reserves of hydroelectric power, has a freer choice of power sources than most other countries, there are sound reasons for proceeding to develop nuclear power. (NO)

26310 NUCLEAR PHYSICIST AND NUCLEAR ENERGY. Van der Walt, B. Tegnikon; 21: No. 2, 30-33(Jun 1972). (In Afrikaans).

From symposium on the future of nuclear physics in South Africa; Pretoria, South Africa (5 Nov 1971).

The position of nuclear power in the world situation is discussed. Various types of nuclear fuels are considered. Attention is then given to thermonuclear power. Because of the high costs involved accelerator facilities should be built on a national scale and not per institution. (INIS)

26311 NUCLEAR POWER PLANTS AND RELIABILITY. Le Ralle, J. C. (CEA, Paris). Energ. Nucl. (Paris); 15: No. 3, 201-207(May 1973). (In French).

During 1972, 18 new power producing nuclear reactors were started-up in the world (9800 MW(e)). As a result, the total power produced on the 31st of December 1972 was 38,900 MW(e) (129 units in 17 countries). The distribution of the different types of reactors and the growth of the nuclear power available are discussed together with the number of nuclear power units installed between the 31st of December 1971 and the 31st of December 1972. The crude charging factors calculated enable the operational behavior of each reactor unit to be determined in relation to other types of reactor and to the same type of reactor. The crude electricity production index can also be determined. Comparisons of the values obtained for these indices demonstrated these reactors to have an overall reliability of 64%; the reliability of reactors in which powers in excess of 100 MW(e) had been obtained for more than one year is 71%. (FR)

Reactor Fuel Cycle Economics

Refer also to abstracts 25961 and 26088.

26312 (IEA-21) INTRODUCTORY COURSE TO THE STUDY OF FUEL CYCLES. da Costa, J. R. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Mar 1972. 185p. (In Portuguese). Dep. NTIS (U. S. Sales Only) $11.25.

26313 FUEL CYCLE OPTIMISATION: THE NEED FOR COOPERATION BETWEEN USER AND FUEL SUPPLIER. Kavanagh, M. T.; Simons, H. K.; Dodds, R. Technical Meeting No. 5/12. Basel; Nuclex (1972). 13p.

From international nuclear industries fair; Basel, Switzerland (16 Oct 1972).

The advantages to be gained by both user and fuel supplier from close cooperation in commercial, design and operational areas are discussed. The pattern of such cooperation between user and supplier in the United Kingdom is described and evidence is presented of the success achieved as a result. Guarantees in the context of fuel supplier are discussed with some analysis of the advantages and disadvantages of different types of guarantees. (auth)

26314 FUEL CYCLE COST ANALYSIS. Gersten, G. W. (Preussische Elektrizitaets AG, Hanover). pp 173-189 of Bid Evaluation and Implementation of Nuclear Power Projects. Vienna; International Atomic Energy Agency (1972).

Procedures exist for calculating fuel costs of a nuclear reactor as accurately as may be required. The input data for a fuel cost calculation are usually fairly well known. At present there is no indication of serious future shortages in one of the products or services of the nuclear fuel cycle. The various prices and services involved are not expected to change to such a degree that it would seriously affect nuclear power's position competitively in reference to other sources of energy. At present the main concern is to have fuel elements designed and fabricated in such a way that they reliably reach the envisaged burnup without impairing the availability of the nuclear power plant. (INIS)

Reactor Licensing and Regulation

Refer also to abstracts 26186 and 26300.

26315 (BNWL-SA-4860) GENESIS OF AN ENVIRONMENTAL STATEMENT: NUCLEAR POWER REACTOR. Schwendiman, L. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 3 Dec 1973. Contract AT(45-1)-1830. 22p. Dep. NTIS $3.25.

Over the past four years a procedure has been developed and instituted by the AEC through which the requirements of the National Environmental Policy Act of 1969 are fully realized. The procedure insures an independent assessment of the Applicant's Environmental Report by scientists and engineers in contractor laboratories, and through extensive interfacing with the Applicant, local and federal government agencies. The procedure permits intervenors as well as advocates to be heard, and finally permits an independent board to make an overall assessment of the environmental and safety issues and make recommendations to the AEC for appropriate action. The process is time-consuming, yet assures the protection of the environment and people in the environment of the nuclear facility. Progress is being made to shorten the procedure through use of more standard reactor designs and stressing the unique features which may require unusually detailed assessment. (auth)

26316 (DOCKET-50003-253) INDIAN POINT STATION, UNIT 1. Abnormal Occurrence Report No. AO-4-1-4: Unplanned Release of About 900 Gallons of Liquid Waste to Discharge Channel. (Consolidated Edison Co. of New York, Inc., New York (USA)). 4 Feb 1974. 1p. Dep. NTIS $3.00.

26317 (DOCKET-50003-254) INDIAN POINT STATION, UNIT 1. Abnormal Occurrence Report No. AO-4-1-5: A Fast Insertion of the Reactor was Initiated by a Position Failure of Control Rod No. 6 in Group A. (Consolidated Edison Co. of New York, Inc., New York (USA)). 6 Feb 1974. 1p. Dep. NTIS $3.00.

26318 (DOCKET-50003-255) INDIAN POINT STATION, UNIT 1. Abnormal Occurrence Report No. AO-4-1-4: Survey of the Utility Tunnel Showed that the Floor was Contaminated. (Consolidated Edison Co. of New York, Inc., New York (USA)). 8 Feb 1974. 1p. Dep. NTIS $3.00.

26319 (DOCKET-50010-220) DRESDEN NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Semi-Annual Report, July 1, 1973–December 31, 1973. (Commonwealth Edison Co., Chicago, Ill. (USA)). 25 Feb 1974. 106p. (DOCKET-50237-462; DOCKET-50249-358). Dep. NTIS $7.50.

Information is presented concerning operations, power generation, maintenance, shutdowns, changes, tests, and experiments for the three reactors. (FS)

26320 (DOCKET-50010-221) DRESDEN NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Semi-annual Report on Radioactive Waste and Environmental Monitoring, July–December 1973. (Commonwealth Edison Co., Chicago, Ill. (USA)). Feb 1974. 85p. (DOCKET-50237-464; DOCKET-50249-359). Dep. NTIS $6.25.

Gaseous and liquid effluents for the period remained below the Technical Specification limits. Calculations of environmental concentrations based on effluent, Illinois River flow, and meteorological data for the period indicate that consumption by the public of radioactive materials attributable to the plant are unlikely to exceed one percent of those that could result from continuous exposure to the concentration values listed in Appendix B, Table II of 10CFR20. Gamma radiation exposure from noble gases released to the atmosphere represented the critical pathway for the period with a maximum individual dose estimated to be 6 mrem for the six-month period and 13 mrem for the January–December period, when a shielding and occupancy factor of two is assumed. Environmental monitoring results confirm that dose via other pathways was not significant. (auth)

26321 (DOCKET-50029-295) YANKEE NUCLEAR POWER STATION. Monthly Report No. 150, June 1973. (Yankee Atomic Electric Co., Westboro, Mass. (USA)). 16 Aug 1973. 21p. Dep. NTIS $3.25.

The reactor operated at 184.9 MW(e) with no abnormal occurrences and with three outages due to a system-wide electrical disturbance, a manual trip due to a fire around a turbine bearing, and a manual scram due to the loss of the Z-126 Hi Line. The MW(t) versus MW(e) and condenser back pressure graphs were revised. A test to find changes in core flow as a result of the installation of a new control rod shroud was performed. During the outage due to the electrical disturbance, hot rod drop time tests were completed. Routine preventive maintenance was completed and all plant surveillance procedures were satisfactorily completed. Chemistry and Health Physics operations are summarized. (FS)

26322 (DOCKET-50155-196) BIG ROCK POINT NUCLEAR PLANT. Semi-annual Operations Report No. 19, July 1, 1973–December 31, 1973. (Consumers Power Co., Jackson, Mich. (USA)). 27 Feb 1974. 75p. Dep. NTIS $5.75.

The plant was base loaded at 69 MW(e) with off-gas release averaging approximately 2,500 μCi/sec. The average output was 67.5 MW(e) or 90% rated power. Information is presented concerning changes in plant design, procedures, specifications, and personnel; performance characteristics; results of surveillance tests and inspection; shutdowns; radioactive effluent releases; environmental monitoring; and occupational exposures. (FS)

26323 (DOCKET-50213-272) HADDAM NECK PLANT. Abnormal Occurrence Report No. AO-74-2: Malfunction of Two Main Steam Line Excessive Flow Differential Pressure Transmitters. (Connecticut Yankee Atomic Power Co., East Hampton (USA)). 28 Jan 1974. 1p. Dep. NTIS $3.00.

26324 (DOCKET-50213-273) HADDAM NECK PLANT. Abnormal Occurrence Report No. AO-74-1: Unsatisfactory Test of Timers Associated With the Emergency Diesel Generator/Core Cooling Systems. (Connecticut Yankee Atomic Power Co., Hartford (USA)). 28 Jan 1974. 2p. Dep. NTIS $3.00.

26325 (DOCKET-50213-277) HADDAM NECK PLANT. Semiannual Operating Report No. 73-2, July 1, 1973–January 1, 1974. (Connecticut Yankee Atomic Power Co., Hartford (USA)). 28 Feb 1974. 28p. Dep. NTIS $3.50.

Near the end of the last six month reporting interval the plant was removed from service to investigate increased turbine vibration, localized at the #6 bearing. The #2 Low Pressure Turbine was disassembled and inspected. Two blades and one piece of shroud were found missing from the 6th rotating stage (generator end). One blade and a piece of shroud were missing from the 7th stationary row. All sixth row blades (rotating and stationary) were removed and the unit was reassembled and returned to service at a vendor imposed limit of 515 MW(e). Plans were developed to replace the 6th row blades during the fall refueling shutdown. On July 8, turbine vibration alarms were received at the main control board indicating a problem with the #2 Low Pressure Turbine. A load reduction was commenced when local readings confirmed the main control board annunciated alarms, and the unit was removed from service. Later disassembly and inspection of the #2 Low Pressure Turbine revealed extensive damage to the 7th rows, both stationary and rotating. One blade and one piece of shroud were missing from the 7th rotating row. Six blades and three shroud sections were missing from the 7th stationary row. Nondestructive testing revealed numerous cracks in the first serration of many of the rotor steeples in the 6th and 7th rows. Top serrations from selected rotor steeples were removed for metallurgical examination. As a result of metallurgical examinations performed by the vendor, a decision was reached on August 2, 1973 to replace the two low pressure turbine rotors before the unit was returned to service. The rotors were replaced with rotors available in the vendor's shop. These rotors required minor modifications and repairs before installation. A decision was also reached in August to advance the refueling date and complete the work during the current shutdown. By the end of November the "B" Low Pressure Turbine was in place with the upper half components installed. A blade frequency modification program was completed on the new "A" Low Pressure Turbine after a similar frequency modification was successfully tested on the old "A" Low Pressure Turbine. The "A" Low Pressure Turbine was then installed and the entire unit was ready for service by mid December. The generator was phased to the electrical grid on December 14, ending a five month long outage. During the remainder of the report period the unit was operated at full licensed capability except for three shutdowns for turbine/generator balancing and main generator/exciter maintenance. Power generation, reactor maintenance, radioactivity releases, and occupational personnel radiation exposure data are presented. (auth)

26326 (DOCKET-50219-403) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report No. 74-4:

Malfunction of Main Steam Isolation Valve NS03B. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 25 Jan 1974. 5p. Dep. NTIS $3.00.

26327 (DOCKET-50219-416) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Semi-Annual Report No. 9, July 1, 1973–December 31, 1973. (Jersey Central Power and Light Co., Morristown, N.J. (USA)). 1 Mar 1974. 70p. Dep. NTIS $5.50.

The plant operated with an availability factor of 82.3% and a capability factor of 72.6%. There were four plant shutdowns which included two unplanned automatic reactor scrams. The two planned shutdowns were for high unidentified drywell leakage and snubber inspection/maintenance respectively. The rate of electrical load increase was restricted for a period of 17 days due to high condensate demineralizer differential pressure. Demineralizer regeneration prior to and during this time was restricted by radwaste difficulties. Because of AEC concern on fuel densification phenomenon, new thermal limits, i.e., the maximum average and maximum local planar linear heat generation rates, were established for the four types of Oyster Creek fuel. Conformance to these limits proved operationally restrictive and resulted in an approximate 5% loss in generation until the limits were relaxed. Operating recommendations for power load changes to minimize fuel failures induced by fuel pellet-clad interactions were followed when possible. Due to control valve problems following startup after the refueling outage, oscillations in load were encountered in the range of 515 to 570 MW(e). This continued until corrected in September. Therefore, load changes in this region were accomplished at a rate greater than that established in the interim operating recommendations. Desirable margins from minimum critical heat flux ratio, maximum average linear heat generation rate, and peaking factor limits were maintained. The rod worth minimizer was successfully used for all reactor startups. Maintenance is summarized. A total of 13,817,745 liters of water was processed with 6,549,564 liters discharged to the environment. Airborne activity released consisted of 180,781 Ci of noble gases, 1.8323 Ci of halogens, 0.1705 Ci of T, and 0.1808 Ci of particulate gross activity. A total volume of 15,385 ft^3 of solid waste containing 484.18 Ci of activity was shipped in 71 shipments. Three shipments of resin containing 234 ft^3 with 1489.2 Ci of activity were made. Atmospheric radiation, fallout, domestic water, surface water, and marine life were monitored and are reported. All chemical and radiochemical parameters for the primary coolant circuit were within specification limits at all times. Facility changes, tests and experiments, and a summary of personnel radiation exposure are presented. (FS)

26328 (DOCKET-50220-232) NINE MILE POINT NUCLEAR STATION, UNIT 1. Semi-annual Report of Operation, July 1, 1973–December 31, 1973. (Niagara Mohawk Power Corp., Syracuse, N. Y. (USA)). 28 Feb 1974. 57p. Dep. NTIS $5.00.

Net electrical generation for the second half of 1973 totaled 2,127,455 megawatt hours with the unit on load 93.6% of the period. Electrical production for the six months was at 79.0 percent of the 610 MW net registered electrical capacity. A summary of station operating statistics is given. A listing of reactor shutdowns and scrams is also given. The unit carried load continuously for 102 days. A tabulation of Maintenance work on safety related systems is included. No major additions or changes to the station were made during this period. The Monthly Chronical of Operations delineates the maintenance details following equipment failure or malfunction resulting in down time. The statistics of effluent and environmental monitoring are listed. The airborne and liquid release data are given for the entire year 1973 on the standardized form suggested in Safety Guide 21. Liquid releases totaled 40.8 curies for the year which amounted to 2.26% of Technical Specification M.P.C. Airborne releases were 3.9% of Technical Specification limits for noble gases and 4.6% for iodine and particulates. A tabulation of Instrument work by the Instrument and Control Supervisor reflects fairly routine operation in these areas. All thermal cycles sustained by the Unit from start-up are tabulated. (auth)

26329 (DOCKET-50245-333) MILLSTONE NUCLEAR POWER STATION, UNITS 1 AND 2. Study of Feedwater Spargers to Determine Why Cracks Appeared in the Spargers. (Millstone Point Co., Hartford, Conn. (USA)). 28 Jan 1974. 4p. (DOCKET-50336-110). Dep. NTIS $3.00.

26330 (DOCKET-50245-334) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Recent Problems and Repairs Associated With "B" Automatic Pressure Relief Valve (S/N 2 APR). (Millstone Point Co., Hartford, Conn. (USA)). 1 Feb 1974. 2p. Dep. NTIS $3.00.

26331 (DOCKET-50247-209) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. AO-4-2-7: Both Doors of the 80 Foot Elevation Personnel Air Lock to the Containment Building Were Inadvertently Opened at the Same Time. (Consolidated Edison Co. of New York, Inc., New York (USA)). 6 Feb 1974. 2p. Dep. NTIS $3.00.

26332 (DOCKET-50247-210) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. AO-4-2-6: When the Reactor was Brought Critical, the Position of the Control Rods was About 27 Steps Below the Insertion Limit. (Consolidated Edison Co. of New York, Inc., New York (USA)). 8 Feb 1974. 2p. Dep. NTIS $3.00.

26333 (DOCKET-50250-196) TURKEY POINT PLANT, UNITS 3 AND 4. Semi-annual Operating Report, July 1, 1973–December 31, 1973. (Florida Power and Light Co. (USA)). 25 Feb 1974. 177p. (DOCKET-50251-180). Dep. NTIS $11.00.

Operating reports of both units are presented in a single report. Sections on power generation, shutdowns, and maintenance are separated by unit. Information on maintenance of equipment common to both units is included only with the Unit 3 maintenance. Information in all other sections is applicable to both units unless one unit is specifically indicated. Unit 3 completed power escalation testing through 75% rated power during this period. Main steam line vibration problems caused the plant management to limit Unit 3 to 80% rated power. Modifications to the steam lines were accomplished allowing the unit to escalate to 98% of rated power (about 745 MWe). Unit 4 encountered vibration problems similar to those on Unit 3 as power was increased to 75%. Power escalation testing was completed through 75% rated power on Unit 4, but the steam line modification was not accomplished to allow operation at higher power levels. On November 1, the International Brotherhood of Electrical Workers went on strike against Florida Power and Light Company. The union represents all company bargaining unit employees, including licensed and unlicensed plant operators and all maintenance personnel below the supervisor level. Operation of both nuclear units continued during the strike, using supervisors and technicians in all capacities. The strike lasted through the end of the reporting period and subsequently ended on February 2, 1974. (auth)

26334 (DOCKET-50250-197) TURKEY POINT PLANT, UNITS 3 AND 4. Semi-Annual Environmental Monitoring Report No. 2, July 1, 1973–December 31, 1973. (Florida Power and Light Co. (USA)). 28 Feb 1974. 287p. (DOCKET-50251-181). Dep. NTIS $16.50.

Records are presented of monitoring requirement surveys and samples, changes in survey procedures, violations of the environmental specifications, unusual events, changes at the plant, changes of the environmental specifications, and permit changes. A list is given of special environmental studies related to the facility, which are not required by the specifications. Results are discussed of the chemical, thermal, ecological analysis of the data. The recovery and revegetation of the cooling canal discharge area are described. (FS)

26335 (DOCKET-50254-326) QUAD-CITIES STATION, UNITS 1 AND 2. Semiannual Report on Radioactive Waste and Environmental Monitoring, July 1, 1973–December 31, 1973. (Commonwealth Edison Co., Chicago, Ill. (USA)). 25 Feb 1974. 65p. (DOCKET-50265-307). Dep. NTIS $5.25.

Gaseous and liquid effluents for the period remained at a fraction of the Technical Specification limits. Calculations of environmental concentrations based on effluent, Mississippi River Flow, and meteorological data for the period indicate that consumption by the public of radioactive materials attributable to the plant is unlikely to exceed 1% of those that could result from continuous exposure to the concentration values listed in Appendix B, Table II of 10CFR20. Gamma radiation exposure from noble gases released to the atmosphere represented the critical pathway for the period with a maximum individual dose estimated to be 6 mrem for the six-month period, and 9 mrem for the year 1973, when a shielding and occupancy factor of two is assumed. Environmental monitoring results confirm that dose via other pathways was not significant. (auth)

26336 (DOCKET-50254-327) QUAD-CITIES STATION, UNITS 1 AND 2. Semiannual Report, July 1, 1973–December 31, 1973. (Commonwealth Edison Co., Chicago, Ill. (USA)). 25 Feb 1974. 71p. (DOCKET-50265-308). Dep. NTIS $5.75.

Reactor operations are summarized including procedure changes, surveillance tests, leak rate tests, design changes, experiments, and complete chronological histories. Power generation, reactor shutdowns, facility modifications, maintenance, and occupational personnel radiation exposures are briefly described. (FS)

26337 (DOCKET-50255-224) PALISADES NUCLEAR PLANT. Report CEN-2(P)-01, Steam Generator Tube Examination and Repair. (Consumers Power Co., Jackson, Mich. (USA)). 26 Feb 1974. 42p. Dep. NTIS $4.25.

26338 (DOCKET-50261-325) H. B. ROBINSON PLANT, UNIT 2. Semi-Annual Operating Report No. 7, July 1, 1973–December 31, 1973. (Carolina Power and Light Co., Raleigh, N.C. (USA)). 26 Feb 1974. 136p. Dep. NTIS $9.00.

The reactor returned to 100% full power operation on July 26 after resolution of questions involving fuel densification and subsequent initiation of a formalized core surveillance program. Operation since that time has been of a routine nature except for a forced outage in November requiring plugging of a leaking tube in steam generator "C". Information is included regarding power generation, modification, abnormal conditions, shutdowns, and maintenance. Separate sections are utilized to describe performance characteristics, surveillance tests performed, changes in operating procedures, radioactive effluent releases, occupational personnel radiation exposures, and environmental monitoring. (auth)

26339 (DOCKET-50265-293) QUAD-CITIES STATION, UNIT 2. Abnormal Occurrence Report: The Setpoint of One High Drywell Pressure Instrument Drifted. (Commonwealth Edison Co., Cordova, Ill. (USA)). 25 Jan 1974. 2p. Dep. NTIS $3.00.

26340 (DOCKET-50265-294) QUAD-CITIES STATION, UNIT 2. Abnormal Occurrence Report: Intermittent Failure of a Reactor Water Level Instrument and Subsequent Valving Error Following Maintenance. (Commonwealth Edison Co., Cordova, Ill. (USA)). 26 Jan 1974. 3p. Dep. NTIS $3.00.

26341 (DOCKET-50269-195) OCONEE NUCLEAR STATION, UNIT 1. Abnormal Occurrence: The Level of Radioactivity in the Reactor Coolant Appeared to Exceed a Level Attributable to Corrosion Products and Tramp Uranium. (Duke Power Co., Charlotte, N. C. (USA)). 31 Jan 1974. 2p. Dep. NTIS $3.00.

26342 (DOCKET-50269-198) OCONEE NUCLEAR STATION, UNIT 1. Abnormal Occurrence Report No. AO-74-1: Isolation of Underground Feeder. (Duke Power Co., Charlotte, N. C. (USA)). 8 Feb 1974. 3p. Dep. NTIS $3.00.

26343 (DOCKET-50269-202) OCONEE NUCLEAR STATION, UNITS 1 AND 2. Semiannual Operating Report, July 1, 1973–December 31, 1973. (Duke Power Co., Charlotte, N.C. (USA)). 1 Mar 1974. 424p. (DOCKET-50270-167). Dep. NTIS $23.25.

Information is presented concerning cooling water system's thermal limits, chemical discharge limits, general aquatic surveillance, fish impingement on the intake screens, entrainment of larvae and fish eggs, plankton entrainment and mortality, plume mapping for temperature, dissolved oxygen, and gas-bubble disease. Data concerning reactor operation, performance, changes in design and operating methods, tests, maintenance, radioactive effluent releases and environmental monitoring are described. (FS)

26344 (DOCKET-50280-217) SURRY POWER STATION, UNITS 1 AND 2. SOR-3, Semiannual Operating Report, July 1, 1973–December 31, 1973, Volume I. (Virginia Electric and Power Co., Richmond (USA)). 1 Mar 1974. 533p. (DOCKET-50281-177). Dep. NTIS $28.75.

The radiological and non-radiological monitoring programs are described. Information is presented concerning radioactive effluent releases, fuel shipments, occurrences in which temperature limitations on condenser cooling discharges were exceeded, and organizational changes. Operating summaries are also included. (FS)

26345 (DOCKET-50280-219) SURRY POWER STATION, UNIT 1. First Year Operation Report. (Virginia Electric and Power Co., Richmond (USA)). 4 Mar 1974. 110p. Dep. NTIS $7.50.

Evaluations of the performance are presented concerning the following systems: cooling, containment, safety injection, safeguards, electric, chemical and volume control, auxiliary, secondary, radioactive waste, and instrumentation and control. Items requiring consideration and resolution include means of limiting hydrogen concentration in the containment after LOCA, spray pump motors, lock out power to a valve in the RHR system, automatic gate valves to isolate the accumulator, common mode failure, and anticipated transients without trip, instrumentation for postulated accidents, integrity of stainless steel piping, key interlock to prevent operation of hot leg injection, motor operated valves, steam line modifications, loose parts monitoring system. Start-up testing is also reported. (FS)

26346 (DOCKET-50295-245) ZION NUCLEAR PLANT, UNITS 1 AND 2. Semiannual Report, July–December 1973. (Commonwealth Edison Co., Chicago, Ill. (USA)). 25 Feb 1974. 98p. (DOCKET-50304-176). Dep. NTIS $7.00.

Unit 1 continued with its start-up and power ascension program reaching a power level of approximately 67%, the maximum which could be obtained without exceeding a pressure differential limitation across the main steam line check valves. The 25% and 50% power plateau testing programs were completed. Flux mapping surveillance at 67% showed normal power distribution. Tests proved that power tilting found at zero power levels could not be due to a broken control cluster rod remaining in the core. Unit 2 attained criticality on December 24, 1973. Zero power physics tests were performed before initial synchronization of the generator to the grid. After the initial synchronization, unit 2 was brought to cold shutdown for maintenance. Summaries for both units are given for corrective maintenance, changes, tests, experiments, containment leak rate tests, primary coolant radioactivity levels, plant personnel, and technical specifications. (FS)

26347 (DOCKET-50295-248) ZION NUCLEAR PLANT, UNITS 1 AND 2. Operational Environmental Monitoring in Lake Michigan, Semiannual Report, July 1973–December 1973, Volume I. (Commonwealth Edison Co., Chicago, Ill. (USA)). 1973. 511p. (DOCKET-50304-178). Dep. NTIS $27.75.

In a field chemistry study, the spatial distributions of the concentrations of selected chemical and physical parameters of southwestern Lake Michigan were analyzed. A water quality monitoring program, which is part of the intake-discharge experiments, measured the effects of condenser passage and discharge on chemical water quality. Results indicated that concentrations remain practically stable. Seasonal abundance of biomass and chlorophyll a was studied to discover possible effects of thermal effluents on periphyton communities. The phytoplankton populations are reported in an offshore study. (FS)

26348 (DOCKET-50295-249) ZION NUCLEAR PLANT, UNITS 1 AND 2. Operational Environmental Monitoring in Lake Michigan, Semiannual Report, July 1973–December 1973, Volume II. (Commonwealth Edison Co., Chicago, Ill. (USA)). 1973. 353p. (DOCKET-50304-179). Dep. NTIS $19.75.

Continuing studies are reported concerning the effects of thermal effluents from Zion and Waukegan generating stations on the phytoplankton communities, the immediate and long-term mechanical, hydrodynamic, and thermal effects of condenser passage on the phytoplankton community, distribution of zooplankton in Lake Michigan near Zion and Waukegan, the zooplankton population in the intake forebay, and the short term effects of condenser passage on zooplankton survival. (FS)

26349 (DOCKET-50295-250) ZION NUCLEAR PLANT, UNITS 1 AND 2. Operational Environmental Monitoring in Lake Michigan, Semiannual Report, July 1973–December 1973, Volume III. (Commonwealth Edison Co., Chicago, Ill. (USA)). 1973. 413p. (DOCKET-50304-180). Dep. NTIS $22.75.

The distribution, abundance, and community structure of benthic organisms were studied. The greatest abundance of benthic organisms was found at 12 and 18 meter depths. Fish eggs and larvae were sampled using a bottom pump, surface and midwater plankton nets, and bottom trawls. Alewife, smelt, slimy sculpins, carp, spottail shiner, yellow perch, ninespine, stickleback, and Notropis spp were collected. Differences in catches were noted by depth. Differences in night and day catches were also noted. Adult fishes were sampled with trawls, gill nets, and minnow seines. Food habits of yellow perch, lake trout and sculpins are discussed. Monitoring of the traveling screens is reported. (FS)

26350 (DOCKET-50298-121) COOPER NUCLEAR STATION. Abnormal Occurrence Report No. AO-74-1: The Emergency Ventilation System was not set up for Automatic Actuation during Fuel Loading. (Nebraska Public Power District, Columbus (USA)). 7 Feb 1974. 3p. Dep. NTIS $3.00.

26351 (DOCKET-50298-123) COOPER NUCLEAR STATION. Abnormal Occurrence Report No. AO-74-2: The Standby Liquid Control System Sodium Pentaborate Solution Did Not Meet Specifications. (Nebraska Public Power District, Columbus (USA)). 13 Feb 1974. 4p. Dep. NTIS $3.00.

26352 (DOCKET-50322-46) SHOREHAM NUCLEAR POWER STATION, UNIT 1. Effects of Postulated Pipe Breaks in High Energy Lines Outside the Primary Containment Structure. (Long Island Lighting Co., Hicksville, N. Y. (USA)). 31 Jan 1973. 143p. Dep. NTIS $9.25.

26353 (DOCKET-50354-100) HOPE CREEK GENERATING STATION, UNITS 1 AND 2. AEC Final Environmental Statement. (Public Service Electric and Gas Co., Newark, N.J. (USA)). Feb 1974. 460p. (DOCKET-50355-100). Dep. NTIS $25.00.

The environmental effects of construction and operation of the Hope Creek Station, Units 1 and 2 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

26354 (DOCKET-50395-59) VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1. Response to RO Bulletins re Limitorque Valve Operator Failures, Defective Hydraulic Shock Suppressors and Restraints, and Malfunction of Containment Purge Supply Valve Switch. (South Carolina Electric and Gas Co., Columbia, S. C. (USA)). 29 Jan 1974. 4p. Dep. NTIS $3.00.

26355 (DOCKET-50409-103) LACROSSE BOILING WATER REACTOR. Annual Report on Radioactive Effluents and Environmental Monitoring, 1973. (Dairyland Power Cooperative, La Crosse, Wis. (USA). 1 Mar 1974. 29p. Dep. NTIS $4.50.

26356 · (DOCKET-50475-1) QUANICASSEE PLANT, UNITS 1 AND 2. Application for Reactor Construction Permit and Operating License. (Consumers Power Co., Jackson, Mich. (USA)). 28 Feb 1974. 93p. (DOCKET-50476-1). Dep. NTIS $7.75.

An application to construct and operate a proposed two unit PWR type power plant located in Hampton Township Bay County Michigan, to generate electrical energy for an integrated electrical system was filed. Each reactor will operate at 3,425 MW(t) with a unit capacity of approximately 1,150 net MW(e). Financial data for the applicant are also given. (FS)

26357 (DOCKET-STN-50477-1) ATLANTIC GENERATING STATION, UNITS 1 AND 2. Application for Licenses. (Public Service Electric and Gas Co., Newark, N.J. (USA)). 1 Mar 1974. 103p. (DOCKET-STN-50478-1). Dep. NTIS $7.25.

An application for the construction of site related structures and the installation and operation of two floating nuclear power plants to be located in the Atlantic Ocean about 2.8 statute miles off the New Jersey coastline at approximately 39°28′20″ N latitude and 74°15′20″ W longitude was filed. Financial qualifications for the applicant and other owners are given. (FS)

26358 (FIND-50003) FIND: INDIAN POINT STATION, UNIT 1. Williams, W. H. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Feb 1974. 37p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc. and refer to grid coordinates on microfiche sheets prepared for each docket report. (auth)

26359 (FIND-50434) FIND: SURRY POWER STATION, UNITS 3 AND 4. Asher, J. M. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Feb 1974. 30p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (auth)

26360 (PRDI-74-3) TITLE LISTING OF POWER REACTOR DOCKET INFORMATION. (USAEC Technical Information Center, Oak Ridge, Tenn.). Mar 1974. 72p.

Citations and subject indexing to the documentation associated with civilian nuclear power plants are presented. This material is that which is submitted to the Atomic Energy Commission in support of applications for construction and operating licenses. Citations are listed by Docket number in accession number sequence. The Table of Contents is arranged both by Docket number and by power plant name. (JWR)

26361 (RAI-73-INDEX-2) INDEXES TO REGULATORY ADJUDICATION ISSUANCES, JANUARY–DECEMBER 1973. (USAEC Technical Information Center, Oak Ridge, Tenn.). Mar 1974. 168p. TIC $7.60.

Digests and indexes for the issuances of the Atomic Safety and Licensing Board, the Atomic Safety and Licensing Appeal Board, and regulatory issuances of the Commission for the period January 1973 through December 1973 are presented. The information is displayed in five separate formats: case name index; digests and headers; legal citation index; subject index; and facility index. (DCC)

26362 (RDT-F-1-3-T) PREPARATION OF UNUSUAL OCCURRENCE REPORTS. (USAEC Division of Reactor Research and Development, Washington, D. C.). Feb 1974. 15p. RSO.

Requirements for reporting unusual occurrences and instructions for preparing unusual occurrence reports are presented. This standard applies to all activities under the cognizance of the Division of Reactor Research and Development. (JWR)

GENERAL

26363 (NP-19951) NATIONAL STANDARDS LABORATORY BIENNIAL REPORT, 1971-1973. (Commonwealth Scientific and Industrial Research Organization, Sydney (Australia)). [nd]. 123p. Dep. NTIS (U. S. Sales Only) $8.25.

This report describes the activities of the laboratory in: length interferometry; engineering metrology; photogrammetry; mass, volume, density, and pressure measurement; force, hardness, and materials testing machines; vibration; corrosion; time and frequency; acoustics; electrical standards; power frequency; high voltage; rf and microwave measurement; temperature measurement; optical radiometry; optics; dielectrics; magnetics; thermal and elastic properties of solids; electron transport in metals; low-energy collisions in gases; physics of the fluid state and high pressures; water vapor physics; viscometry; airglow; solar physics; and theoretical astrophysics. (DLC)

26364 (NP-19953) AUSTRALIAN ATOMIC ENERGY COMMISSION TWENTY-FIRST ANNUAL REPORT, 1972-1973. (Australian Atomic Energy Commission, Coogee). [nd]. 128p. Dep. NTIS (U. S. Sales Only) $8.50.

Research and development progress is reported in sections on nuclear power, uranium, uranium processing, public health, radioisotopes and radiation, research services, international matters, and general activities. (JRD)

26365 (NP-19961) PROGRESS REPORT OF NUCLEAR ENERGY RESEARCH IN JAPAN. (Science and Technology Agency, Tokyo (Japan). Atomic Energy Bureau). Jan 1973. 128p. Dep. NTIS (U. S. Sales Only) $8.50.

Research and development progress is reported on nuclear fuel and fuel elements, structural materials for reactors, reactor components, radiation measurement, nuclear powered ships, nuclear fusion, radiological protection, and radioisotope uses. (JRD)

26366 STATE SHOULD BE RESPONSIBLE FOR ALL MAJOR DEVELOPMENT PROJECTS. Vatten, G. (Norge Vassdragsog Elektrisitetsvesen, Oslo). Elektro; No. 17, 21-22(4 Oct 1973). (In Norwegian).

The view is presented that introduction of nuclear power will require a coordination of resources which can only be achieved by a single organization. While no decision has yet been taken the Norwegian Water Resources and Electricity Board (NVE) is responsible to the parliament for the preparatory planning. Three possible organizational forms for further activities are: the state is the sole participant; the electric companies form a common development company without state participation, the state forming the regulatory body; and, a common development company with state and private participation. It is said to be unthinkable that the state would not participate, and a common state-private organization would be cumbersome. In the final instance it is the parliament which will take the decisions, and it is therefore reasonable that the state alone undertake nuclear plant construction. This principle should also be extended to possible gas-fired projects and national hydroelectric plants. Production in private hydroelectric plants should be controlled by a common organization in order to rationalize the system. (NO)

Civilian Defense

26367 (ORNL-tr-2745) CIVIL DEFENSE OF THE USSR: ANTIRADIATION SHELTERS IN RURAL AREAS, INSTRUCTIONS FOR THE POPULATION. Molodykh, V. I.; Nikaronov, A. A.; Korotkevich, E. I.; Koshelev, P. A. (Oak Ridge National Lab., Tenn. (USA)). 1972. Translated by Joseph Lewin from Russian. 48p. Dep. NTIS $4.50.

This handbook gives instructions for the protection of the civilian population of the USSR against radioactivity in the event of nuclear attack. A brief summary of the biological effects of radiation and the symptoms of radiation burns of the skin and radiation sickness is followed by instructions on ways to protect drinking water supplies against radioactive contamination and detailed designs of fallout shelters and instructions for the conversion of existing buildings into shelters and for building shelters for the protection of families or small groups of people. (CH)

26368 GRAZHDANSKAYA OBORONA NA OB'EKTAKH SEL'SKOKHOZYAISTVENOGO PROIZVODSTVA. (Civil Defence in Agricultural Production Areas). Akimov, N. I.; Il'in, V. G. Moscow; Kolos (1973). 432p.

In this textbook for students of agricultural schools the following topics are covered: the nature of rocket-nuclear warfare, the role and problems of civil defense applicable to agricultural production areas; organization of civil defense in agricultural regions, at cooperative farms, and at state farms; the nature of biological, chemical, and radiation surveys and dosimetric control; protection of the population from the action of nuclear, chemical, and biological materials in agricultural production areas; the planning of civil defense problems of organization and supervision of emergency and urgent accident restoration work in the agricultural production areas contaminated by radioactive, chemical, and biological materials and contaminated areas in cities. The book may also be used as a handbook for organizing civil defense and for instructing the population in agricultural production areas. (tr-auth)

Energy Utilization and Economics

Refer also to abstracts 24229 and 25445.

26369 (AD-221574-7) COMPOSITION OF COALBED GAS. Report of Investigations. Kim, A. G. (Bureau of Mines, Washington, D. C. (USA)). May 1973. 13p. NTIS $3.00.

Samples of gas were obtained directly from the coalbed during drilling of horizontal and vertical boreholes in six different formations. The samples were analyzed by gas chromatography for C_1 to C_5 hydrocarbons and for O_2, N_2, H_2, He, and CO_2. Methane in the gas varied from 63 to 99 percent; carbon dioxide from 0.1 to 15 percent. The CH_4/CO_2 ratio varied and showed no apparent correlation with age, rank, or bed. The majority of samples contained ethane, propane, butane; hydrogen and helium were found in some samples. Oxygen and nitrogen were usually present, possibly as a result of air contamination. A more extensive sampling program would be necessary to establish relationship between the amount and composition of the gas in the coalbed and other factors. (GRA)

26370 (ANCR-1139) FY 1974 PROGRAM PLAN FOR GEOTHERMAL PROJECT. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). 5 Feb 1974. Contract AT(10-1)-1375. 76p. Dep. NTIS $5.45.

The Program Plan specifies the basic plan for the utilization of FY-74 funds allocated by the AEC Division of Applied Technology and contributions from other participants for the development of geothermal energy in southern Idaho. Funding priorities are dictated by the Construction Data Package submission deadline and the October 1, 1974, site selection. Tasks not funded during FY-74 will be pursued during FY-75. (auth)

26371 (CONF-740208-1) COAL MINING AND THE ENVIRONMENT. Nephew, E. A. (Oak Ridge National Lab., Tenn. (USA)). 1973. 13p. Dep. NTIS $3.00.

From national western mining conference; Denver, Colorado, USA (9 Feb 1974).

The vast bulk of the U. S. coal resource lies at depths which render it forever inaccessible to recovery by surface mining methods. In the long term, underground mining must become the predominant form of coal extraction. The longwall method of mining shows great potential promise for increasing resource recovery and labor productivity, and for providing safer working conditions. Adverse environmental impacts from deep mining include acid mine drainage, surface subsidence, and gob disposal. Sufficient quantities of coal lie close enough to the surface that surface mining will continue to be a major factor in coal production for decades to come. Full reclamation of strip-mined mountainous lands is especially difficult and laws affecting contour mining and reclamation do not call for full reclamation and are often inadequately enforced. The modified block-cut method of mining represents one possible method for reducing the environmental damages from mountain strip-mining. Special problems occur in arid and semi-arid regions and restoration practices in flat areas should return the land to full agricultural productivity. (MCW)

26372 (CONF-740214-1) NATURE OF DEMAND GROWTH AND IMPLICATIONS FOR ENERGY CONSERVATION. Gill, G. S. (Oak Ridge National Lab., Tenn. (USA)). 1974. 11p. Dep. NTIS $3.00.

From conference on energy conservation research; Warrenton, Virginia, USA (18 Feb 1974).

The demand for electricity in the United States has been consistently growing at 7% per year for most of the post World War II years. If this trend were to persist, the demand for electricity in the year 2000 would be six times the 1970 level. This growth presents two major problems: the potential gaps between the supply of and demand for electricity and the growing stress on the quality of the environment. Research has accordingly been directed towards developing a methodology for an enhanced understanding of the nature of demand growth. Both constant and variable elasticity models provide useful information to the policy makers, public utilities, regulatory agencies, citizens groups, and scientific community for effectively dealing with the present and potential problems. (auth)

26373 (OCR-20) GAS GENERATOR RESEARCH AND DEVELOPMENT. Phase II. Process and Equipment Development. Period of Performance, March 1965–September 1970. Final Report. (Bituminous Coal Research, Inc., Monroeville, Pa. (USA)). Mar 1971. Contract 14-01-0001-324. 571p. GPO $10.25.

On Dec. 20, 1963 a program of gas generator research and development was initiated by Bituminous Coal Research, Inc. for the Office of Coal Research. Phase II involves experimental studies on the two-stage super-pressure coal gasification process initiated in March 1965. Batch tests in rocking autoclaves to continuous flow tests, first in an externally-heated 5 lb/hr flow reactor, and later in an internally-fired 100 lb/hr process and equipment development unit were performed. These experiments confirm the reactions of coal under conditions existing in Stage 2 of the two-stage process. The data were used in the design of a 100 lb/hr internally-fired Stage 2 reactor. Coals ranging in rank from lignite to high volatile A bituminous coal were used without difficulty. Based on results obtained from the 100 lb/hr process and equipment development unit, recommendations were made concerning the design of fully integrated 5 ton/hr pilot plant based on the two-stage super-pressure process. On June 18, 1969 the scope and nature of the Phase II studies were expanded to include additional testing of the Stage 2 PEDU, completion of the engineering design of the pilot plant, additional petrographic analysis, and initiation of bench-scale work on a fluidized-bed unit. In April 1970, work again was expanded to include gas purification and catalytic methanation and the application of fluidized-bed techniques in processes for gasification of char. Engineering evaluation and cost estimates of the two-stage super-pressure gasification process projected to full-scale commercial operation are summarized. The engineering evaluations and cost estimates of processes for a proposed multipurpose research pilot plant facility are reported together with the designing and planning for an oxygen-blown two-stage gasification system as the initial pilot plant in the facility. A summary is provided of the reports and publications emanating from the program. (MCW)

26374 (ORNL-EIS-74-52(Vol.2)(No.1)) NSF–RANN ENERGY ABSTRACTS. A Monthly Abstract Journal of Energy Research. Guthrie, M. P. (Ed.). (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 45p. Dep. NTIS $4.00.

The bibliography contains ninety-three research citations from technical journal articles, popular or semi-technical magazine articles, topical reports, symposium papers and proceedings, monographs, and books published within the past two years. Citations are grouped by subject category headings of energy, energy sources, unconventional energy sources and power generation, electric power, electric power generation, electric power transmission and distribution, energy storage, and energy demand and consumption. (MCW)

26375 (ORNL-NSF-EP-65) ENERGY USE FOR BICYCLING. Hirst, E. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. Contract W-7405-eng-26. 23p. Dep. NTIS $3.25.

Total energy use for bicycling–food, bicycle manufacture and sale, repairs and maintenance, tires, and bikeway construction–amounts to about 1,300 Btu/mile. The comparable figure for urban automobile travel is 11,000 Btu/passenger-mile for trips of five miles or less. Thus a shift from cars to bicycles would save about 10,000 Btu/passenger-mile, a 90% reduction from the energy use for automobiles. If 10% of the urban auto travel conducted during daylight and in good weather for trips of five miles or less was shifted to bicycles, the savings in 1971 would have been 180 trillion Btu, 1.8% of total urban automobile energy use. (auth)

26376 (ORNL-TM-4476) CRYOGENIC POWER TRANSMISSION TECHNOLOGY: CRYOGENIC DIELECTRICS. Quarterly Report, October 1–December 31, 1973. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. Contract W-7405-eng-26. 29p. Dep. NTIS $3.50.

The principal accomplishments reported include technical improvements to the intermediate voltage cryostat, improvements in the test procedure, and the achievement of more reliable breakdown values of liquid helium at atmospheric pressure obtained with gap widths between 0.25 and 3.0 mm. A change of the voltage ramp rates between 0.08 kV/sec and 10.0 kV/sec showed no significant influence on the breakdown values. Due to improvements in the cryostat design, only slow boiling was observed in the helium. Consequently, appropriate statistical evaluation of the breakdown values (considering the relatively small numbers, 12 to 150, obtained with each gap width) showed that the new measurements agree well with measurements of other investigators with externally refrigerated nonboiling helium and are significantly higher than published breakdown values for boiling helium. The experiments were performed with the intermediate voltage cryostat. Several subassemblies of the high-voltage cryostat have been completed. (auth)

26377 (PB-221575-4) GASES DESORBED FROM FIVE COALS AT LOW GAS CONTENT. Report of Investigations. Kim, A. G.; Douglas, L. J. (Bureau of Mines, Washington, D. C. (USA)). May 1973. 13p. NTIS $3.00.

Methane and other hydrocarbon gases, by-products of coalification, are emitted from coal at widely varying rates and often present ventilation problems during mining. The air in some coal mines apparently contains no methane. To determine if coals from mines that had no history of detectable gas emission contained adsorbed methane, samples of coal at the shaft bottom and at an active face were obtained and placed in sealed metal cylinders. The atmosphere around the coal was sampled and analyzed by gas chromatography. Methane, ethane, ethylene, propane, propylene, and butane were found to have been desorbed from these coals. Hydrocarbon and helium were also detected. An estimate of the amount of residual gas per ton of coal indicated that coal samples from the active face generally contained more adsorbed gas than coal samples obtained from the shaft bottom, although in both instances the total amount of gas was relatively small. (GRA)

26378 (PB-221627-3) REMOVAL OF PYRITE FROM COAL BY DRY SEPARATION METHODS. Report of Investigations. Abel, W. T.; Zulkoski, M.; Brady, G. A.; Eckerd, J. W. (Bureau of Mines, Washington, D. C. (USA)). May 1973. 32p. NTIS $3.75.

Sulfur dioxide emissions from coal-burning power plants can be significantly lowered by removing pyrite from the coal prior to burning. Conventional wet washing methods remove pyrite down to fine size; however, because of difficulties associated with wet processing of fine-size coal, dry removal methods offer an attractive alternate. The dry pyrite removal process reported cleans fine-size coals by removing the light-weight, pyrite-depleted portions centrifugally then concentrating the pyrite from the remaining pyrite-enriched portion electrostatically. The dry separation process, when integrated with the grinding operation (stage grinding), was nearly as effective as float-sink separation at 1.6 specific gravity and because of potential advantages may warrant further research on a larger scale. (GRA)

26379 (UCID-16446) GUIDE FOR CALCULATING COLLECTION EFFICIENCY FOR THE SHALLOW SOLAR POND (APPLICABLE FOR ANY HORIZONTAL FLAT PLATE SOLAR COLLECTOR). Dickinson, W. C.; Neifert, R. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Feb 1974. Contract W-7405-Eng-48. 44p. Dep. NTIS $4.25.

The collection efficiency of a solar collector system was calculated by a method of Hottel and Whillier and Liu and Jordan. The method calculates the hourly rate of energy collection and the long term on monthly average collection efficiency based upon monthly average daily solar insolation data and daytime temperatures obtained from Weather Bureau data. The method provides the most realistic values of collection efficiency that can be obtained for a given collector system in a given location. Not only is the monthly variation taken into account but also the statistical effect of bad weather. The "Solar" computer program was written to calculate average hourly values of collected heat and average daily values of collection efficiency. (MCW)

26380 (UCRL-51487) U. S. ENERGY FLOW CHARTS FOR 1950, 1960, 1970, 1980, 1985, AND 1990. Austin, A. L.; Winter, S. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Nov 1973. Contract W-7405-Eng-48. 18p. Dep. NTIS $4.00.

Energy flow charts for the U. S., showing the origin and disposition of energy for the years 1950, 1960, 1970, 1980, 1985, and 1990, are presented along with a discussion of their development and the implications of the data they represent. An appendix describes the construction of one chart in detail, serving as an example of the method. (auth)

26381 (UCRL-51511) RATIONALE FOR SETTING PRIORITIES FOR NEW ENERGY TECHNOLOGY RESEARCH AND DEVELOPMENT. Rubin, B.; Winter, S.; Ramsey, W.; Werth, G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Jan 1974. Contract W-7405-eng-48. 60p. Dep. NTIS $5.00.

A strategy for employing new technologies to meet United States energy shortages by 1985, including a set of ground rules for choosing among different technologies, is presented. Twenty-five technology areas are indicated, each of which meets the ground rules and is potentially capable of providing at least 0.5×10^{15} Btu/yr by 1985. Source energy prices and 1985 energy production quantities are estimated. Total R&D costs are estimated to be $5.7 billion; total production plant capital costs would be about $73 billion. Relative values of different technologies are compared on the basis of city-gate energy prices. Development of these technologies would approximately double the commercially-available fossil fuel reserves, assuming an energy price increase (in 1973 dollars) of about 30% over 1973 prices. Non-fossil reserves also would be greatly increased. Addition of the energy supplies produced by these new technologies to the supplies derived through conventional means could lead to self-sufficiency in energy by the mid-1980's. (auth)

26382 (WASH-1281-1) RESOURCE ASSESSMENT. Subpanel Report I Used in Preparing the AEC Chairman's Report to the President. McCulloh, T. H. (USAEC, Washington, D. C.). 13 Nov 1973. 147p. Dep. NTIS $10.50.

The United States will be primarily dependent for its energy needs upon oil and gas, coal, uranium and hydropower well into the next century. Domestic sources of these supplies will be taxed to the utmost during the 1973–85 period. Options involving different energy mixes, different levels of energy production, and varying environmental and socio-economic impacts may be permitted in the long term by technological progress. However, the necessary decisions regarding such options cannot now be made intelligently without a much better understanding of the domestic energy fuel resource base. Resolution of the energy crisis, which is basically a domestic fuel shortage, will depend primarily on increasing conventional fuel supplies. More effective means for the discovery, evaluation, and development of these supplies are needed. Since the cited fuels and hydropower will remain the prime domestic energy sources for many decades, it is essential to recognize that each is characterized by unique features of availability, usability, and environmental acceptability. They are only partly interchangeable as fuels and more complete interchangeability will require the restructuring of many industrial processes. (auth)

26383 (WASH-1281-2) MINING: COAL AND OIL SHALE. Subpanel Report II Used in Preparing the AEC Chairman's Report to the President. Schmidt, W. B. (USAEC, Washington, D. C.). 27 Oct 1973. 242p. Dep. NTIS $15.25.

Coal and oil shale together constitute 90% of our fossil fuel energy reserves. If these resources are to fulfill the expanding role demanded of them, better mining technology must be developed. This is the research area dealt with by this subpanel. Three subprograms are presented: "surface coal mining", "underground mining", and "oil shale mining". Research for the three subprograms is recommended on the principal problem areas of mining systems, environmental protection, social and economic effects, and resource recovery. The overall objective of the recommended coal and shale research mining program is the rapid development and demonstration of technology to satisfactorily mine these important energy sources. This technology must meet the required demands at acceptable costs with minimal environmental impacts. Also, this mining must be done in a manner that assures miners' health and safety and makes wisest use of these resources. In the near term, the coal surface-mining segment of the program will concentrate on improving extraction/reclamation technology to allow acceptable mining of both Eastern and Western coals at the unprecedented rates anticipated. In the near term, the underground coal mining portion of the program will concentrate on the development of improved underground mining methods to provide a viable complement to our surface coal mining capabilities. The oil shale mining program will concentrate on mining of thick Western shale deposits in a manner that complements emerging government/industry efforts to develop these reserves in an environmentally acceptable manner. (auth)

26384 (WASH-1281-3) FUEL TRANSPORTATION, DISTRIBUTION, AND STORAGE. Subpanel Report III Used in Preparing the AEC Chairman's Report to the President. Seelinger, J. H. (USAEC, Washington, D. C.). 13 Nov 1973. 163p. Dep. NTIS $11.25.

On October 27, 1973, this subpanel recommended R and D funded at a 5-year level of $152.4 million in four subprogram categories: (1) pipelines, (2) ocean delivery systems, (3) large nuclear underground, and (4) hydrogen TDS. The Overview Panel's screening reduced these recommendations to one subprogram (Ship Delivery Systems) at a 5-year funding level of $50 million. Based on this funding, the expected achievements during the next five fiscal years are: (1) detailed design of Arctic surface tankers suitable for transporting oil from certain regions of the Arctic to U. S. East Coast ports safely and economically; (2) detailed design and advanced components for Arctic submarine tankers for use where pipelines and surface tankers are not feasible; (3) detailed design of Arctic marine terminals, both surface and submerged, followed by feasibility demonstration; and (4) acceptance, commitment, and participation in these programs by commercial operators on the basis of established technology and economic desirability. (LMT)

26385 (WASH-1281-4) ENERGY TRANSPORTATION, DISTRIBUTION, AND STORAGE. Subpanel Report IV Used in Preparing the AEC Chairman's Report to the President. (USAEC, Washington, D. C.). 1973. 158p. Dep. NTIS $11.00.

Five year R and D program objectives in transportation and distribution are: (1) continue development of increased-capacity ac and dc overhead power transmission systems by doubling the present capacity by 1985, and achieving a multiplication of 4 to 10 times by the year 2000; (2) to continue the development of reliable and lower-cost underground transmission systems capable of matching future overhead systems in both power capacity and voltage; (3) to develop advanced methods and equipment for systems security and control that will improve reliability and efficiency of generation, transmission, and distribution; and (4) to analyze electrical energy transportation systems development in order to identify the more desirable growth options, and to pursue fundamental investigations that have potential for long-term (beyond 2000 AD) application. Five-year objectives in the area of energy storage are: (1) to support completion of bench models of Na/S and Li/S batteries; (2) to support completion of a 10-mwh pilot model of an advanced battery (Na/S or Li/S); (3) to provide surveillance of Zn/Cl_2 battery development and support fundamental research in electrochemistry; to provide engineering development of superconducting energy storage magnets and flywheels; and to provide for economic assessment of batteries and other storage systems. (auth)

26386 (WASH-1281-5) COAL AND OIL-SHALE PROCESSING AND COMBUSTION. Subpanel Report V Used in Preparing the AEC Chairman's Report to the President. Crentz, W. (USAEC, Washington, D. C.). 27 Oct 1973. 319p. Dep. NTIS $19.00.

Optimistic projections indicate that by 1985 an industrially supported oil-shale industry of about 1,000,000 bbl/day can be developed. From coal, about 1,000,000 bbl/day production of oil and 1.5 trillion cf/year of pipeline-quality gas might be available by 1985, if the Federal government has a strong commitment to achieve that goal. Achievement of this goal would provide for rapid industrial expansion after 1985, but first the threshold must be overcome. During the near-term period, the development of reliable stack gas cleanup systems must be accomplished in order to insure that coal can be burned in central power plants in an environmentally satisfactory manner. Simultaneously, new coal combustion techniques must be developed that have greater efficiency than conventional systems. Stack gas cleanup consumes from 3 to 7% of the power output of a plant. Pressurized fluidized-bed combustion systems will be developed that have the capability of higher thermodynamic efficiencies than conventional systems and also avoid the power losses in stack gas cleanup. The proposed supporting research is an effort parallel with the coal gasification and liquefaction research and focuses sharply upon the equipment and material problems that are encountered in the hostile conditions used in these processes. Commercial development can only follow when there is reasonable assurance of reliable continuous plant operation. The solution to problem areas is usually less costly in the laboratory than in a pilot plant operation. Proposed funding levels for the five subprograms (total $1.22 billion for 5 years) included in this review are presented. (auth)

26387 (WASH-1281-6) CONVERSION TECHNIQUES. Subpanel Report VI Used in Preparing the AEC Chairman's Report to the President. English, R. E. (USAEC, Washington, D. C.). 13 Nov 1973. 355p. Dep. NTIS $20.75.

Improved energy conversion techniques for the reliable generation of electric power and for energy conservation are of great importance, and the goals of this R and D program are to (1) increase the efficiency of use of indigenous energy supplies (coal and uranium as well as new, alternate energy sources), (2) to reduce the environmental impact of this power production, and (3) to reduce the capital cost for construction of new power plants. For the purpose of reaching these goals, the following eight objectives were established: (1) coal gasification: to develop processes for the production and use of clean low-BTU gas from coal in central power stations; (2) gas turbines: to increase the overall efficiency and reliability of power generation by developing high-temperature gas-turbine systems; (3) MHD: to increase the overall efficiency and reliability of power generation by developing MHD power systems; (4) potassium topping cycle: to increase the overall efficiency and reliability of power generation by developing potassium-vapor topping systems; (5) fuel cells: to develop efficient and economical fuel cells for power generation; (6) use of waste heat and fuel: to develop power systems for economical use of heat and fuel presently wasted; (7) advanced concepts: to evaluate, to investigate, and ultimately to develop advanced concepts for energy conversion; and (8) enabling technology: to evolve the basic constituent technologies that enable the substantial improvement of various power systems or that make feasible entirely new concepts for power generation. An implicit constituent of these objectives is to minimize the environmental impact of power generation. These eight objectives represent a significant narrowing of the range of options considered. Under the pressure of severe budgetary constraints, the R and D originally proposed on low-temperature cycles was deferred and converted instead to a study under advanced concepts. Further, the use of waste heat and fuel was confined to the use of solid waste for power generation. (auth)

26388 (WASH-1281-7) ADVANCED METHODS OF OIL AND GAS PRODUCTION FROM FOSSIL FUELS. Subpanel Report VII Used in Preparing the AEC Chairman's Report to the President. Fleming, E. H. (USAEC, Washington, D. C.). 13 Nov 1973. 138p. Dep. NTIS $9.50.

The program recommended by the subpanel consisted of six subprograms. In order to meet the $310 million program level recommended by the Overview Panel, the subprograms for in situ coal gasification and recovery of oil and gas from tar sands and heavy oils were eliminated. The remaining four subprograms and objectives are: (1) oil recovery from fluid injection, demonstrating optimum applications of existing and improved methods for some 60 billion barrels now technologically but not economically recoverable, and an additional 60 billion barrels not now technologically recoverable; (2) oil and gas from stimulating tight formations using nuclear explosives, large-volume hydraulic fractures, and chemical explosives; (3) oil from oil shale by developing appropriate fracturing techniques (e.g., nuclear explosives, chemical explosives, partial mining, hydraulic fracturing, or combinations thereof) and processing methods (e.g., in situ combustion, circulation of hot gases); and (4) oil and gas from advanced drilling technology (primarily jet drilling and spark drilling). The predicted results of the contribution of each subprogram to production levels by 1985 and 1995 are presented, and the comparative roles of government and industry are briefly discussed. (LMT)

26389 (WASH-1281-8) GEOTHERMAL ENERGY PROGRAM. Subpanel Report VIII Used in Preparing the AEC Chairman's Report to the President. (USAEC, Washington, D. C.). 13 Nov 1973. 192p. Dep. NTIS $12.75.

Only one resource type is presently being used to produce power in the U. S.—dry steam generating 400 MWe at The Geysers near Santa Rosa, California. Six other types—brines at high temperature and low salinity, high temperature and high salinity, low temperature and low salinity, and in geopressured reservoirs, plus dry hot rock at shallow depth and in deep, normal-gradient formations—are potentially available for economic energy recovery. The program plan calls for a government budgetary obligation of $40 million during FY-75 coupled with an industrial commitment of $11.7 million. The five-year budgetary obligations are estimated to be $185 million for the government and $60 million for industry. The complete five-year plan plus the balance-to-complete funds is presented. Under this program plan, demonstration plants using four of the six advanced resource types will be completed and operated, jointly with industry, to obtain engineering and economic data. Construction work will be underway on a demonstration plant for a fifth resource type, dry hot rock, and engineering data in support of the design of a sixth plant employing normal-gradient formations will have been collected. It is expected that information from all these systems will accelerate commercialization of geothermal energy. (auth)

26390 (WASH-1281-10) FISSION REACTORS. Subpanel Report X Used in Preparing the AEC Chairman's Report to the President. Kouts, H. J. C. (USAEC, Washington, D. C.). 27 Oct 1973. 297p. Dep. NTIS $18.00.

The Subpanel concludes that a substantially increased Federal effort in the following areas of fission energy research and development are of first importance: (a) safety, performance, and environmental research and development of light-water-reactor and gas-cooled-reactor power plants and the associated fuel cycle; (b) geological survey and exploration for uranium on both a global and national scale; (c) advanced technology programs in fuel and materials including fuel processing and recycling; and (d) liquid-metal fast breeder research, development, and demonstration. In addition, the Subpanel recommends that a vigorous technical and economic evaluation of the light-water breeder reactor be undertaken by a group including industry. Annual expenditures growing to a level of ~$900 million per year in the late 1970's will be necessary for the orderly pursuit of the program's goals and priorities. (auth)

26391 (WASH-1281-11) FUSION ENERGY PROGRAM. Subpanel Report XI Used in Preparing the AEC Chairman's Report to the President. Hirsch, R. L. (USAEC, Washington, D. C.). 27 Oct 1973. 320p. Dep. NTIS $19.00.

The present and proposed national program explores a number of possible approaches to fusion power that can generally be placed in two categories: (1) magnetically contained plasma and (2) laser fusion systems. In (1), receiving 54% of the effort, three types of devices are considered most important: (1) the tokamak, (2) the theta pinch, and (3) the magnetic mirror. The tokamak is the primary concept, receiving about 60% of the present effort, while the other two concepts represent about 20% each. Laser fusion is in an early phase, so that it is possible that in the next few years dramatic progress could occur, or in the opposite extreme, a long systematic research effort may be found necessary. The proposed R and D budget for magnetic confinement shows increasing year-by-year fiscal 1975 through 1979 outlays of $133 through $398 million (total $1.44 billion) for operating equipment, and construction. The laser-fusion budget shows a FY 1975–1979 total of $110 million; this represents an addition for civilian laser fusion research above and beyond a 5-year projected military laser-fusion program totaling $329 million. (LMT)

26392 (WASH-1281-12) END-USE ENERGY CONSERVATION. Subpanel Report XII Used in Preparing the AEC Chairman's Report to the President. Gibbons, J. H. (USAEC, Washington, D. C.). 1973. 226p. Dep. NTIS $14.50.

The goal of the proposed energy conservation R and D program is to decrease the rate of growth in demand for energy and certain fuels and to achieve this decrease while maintaining an acceptable standard of living and environment, under conditions of minimal social and economic dislocation. This program will concentrate on opportunities for effective conservation of energy in the end-use sectors. Major increases in efficiency can be attained through improvement of end-use technologies, better material resource management, substitution of time and materials for energy, and alteration of lifestyles. In developing the program, end-use was divided into three main sectors (transportation, buildings, and industry) in order to inventory the opportunities for saving energy and to define mechanisms for allocating R and D resources. For technical reasons two more research sectors were added (integrated utility systems, and cross-sectoral studies). R and D resources applied to a given sector should generally reflect the magnitude of energy used in each sector multiplied by the potential energy savings in that sector. Obviously, there are additional factors that must be considered in determining research priorities. These include growth rate, role of federal versus private resources, and the extent of research opportunities. The "minimum" program developed by the panel is estimated to ensure a 15% savings before 2000. (LMT)

26393 (WASH-1281-13) TRANSPORTATION SYSTEMS. Subpanel Report XIII Used in Preparing the AEC Chairman's Report to the President. Petrick, E. N. (USAEC, Washington, D. C.). 27 Oct 1973. 314p. Dep. NTIS $18.75.

The transportation energy R and D goal is as follows: to develop the technology necessary to reduce transportation demand for crude oil and other fuels by improved efficiency, new designs with higher efficiencies, and utilization of alternative fuels. Specifically, in pursuit of this goal, the proposed transportation energy R and D program will reduce transportation dependence on crude oil by 22% in the year 1985, 55% in the year 2000, and up to 100% after the year 2000 from the levels of consumption that otherwise would be experienced without the proposed program. The transportation sector is grouped into four subprograms—autos/trucks, air, rail/bus, and ships—for purposes of this program development. The contribution of each to the overall goal, along with a summary of the transportation energy R and D program funding proposal, is presented. (auth)

26394 (WASH-1281-14) ENVIRONMENT. Subpanel Report XIV Used in Preparing the AEC Chairman's Report to the President. Greenfield, S. M. (USAEC, Washington, D. C.). 13 Nov 1973. 402p. Dep. NTIS $23.25.

Two basic conclusions are drawn with respect to the challenge of preventing environmental degradation: first, development and implementation of energy systems for achieving and maintaining energy self-sufficiency clearly must be sensitive to the effects that the systems will have on health, welfare, and ecosystems. Second, if this sensitivity is rationally incorporated into the development and implementation of energy processes, these domestic resources can be broadly utilized in harmony with the environment. The achievement of this second point is the fundamental goal to which this environmental research agenda is directed. This agenda consists of four environmental science subprograms constructed by projecting presently known and anticipated concerns for the impacts of existing and developmental energy systems on the environment. These subprograms are: (1) pollutant characterization, measurement, and monitoring; (2) transport processes; (3) effects (health, ecological welfare, and social); and (4) environmental assessment and policy formulation. A total FY 1975-1979 funding level of $863.7 million is broken down for each year for each subprogram. (LMT)

26395 (WASH-1281-15) MULTIDIRECTIONAL RESEARCH. Subpanel Report XV Used in Preparing the AEC Chairman's Report to the President. Creutz, E. C. (USAEC, Washington, D. C.). 27 Oct 1973. 254p. Dep. NTIS $15.75.

Multidirectional research greatly increases the chances that existing ideas can be successfully developed. At the same time it provides a sound base for new directions when they are needed. That is, research will frequently suggest quite new lines of development not contemplated when the program was first defined. If the technologies now visualized should prove inadequate, then research, if properly encouraged and supported early enough, will lead to modified approaches with increased probability of success. The scope of multidirectional research required in support of the energy research and development program is thus very wide in disciplines and interdisciplinary areas. It is organized into five subprograms: (1) materials research; (2) chemical, physical, and engineering aspects of energy production, utilization, and waste processing; (3) biological generation of fuels, treatment of effluents, the environment, and resources; (4) plasmas, major untapped sources, and new concepts; and energy economics, social response to energy availability and regulation, and mathematical techniques. The funding of each subprogram for the fiscal years 1975-1979 is outlined, with the total for the 5-year period being $250/350 million. (LMT)

26396 (WASH-1281-16) ENERGY SYSTEMS ANALYSIS. Subpanel Report XVI Used in Preparing the AEC Chairman's Report to the President. Gage, S. (USAEC, Washington, D. C.). 27 Oct 1973. 184p. Dep. NTIS $12.25.

This report recommends the establishment of those mechanisms in the Federal Government that would provide for both ongoing planning and management functions based on comprehensive energy systems analyses and research programs to provide the fundamental knowledge and tools required for those analyses. Specifically, it is recommended that the Energy System Analysis Program be composed of the following five elements: (a) energy data base and system modeling; (b) technology assessment of emerging energy systems; (c) social technologies and energy systems; (d) systematic analysis of alternative energy futures; and (e) strategic management and evaluation of energy R and D programs. (auth)

26397 CAN COAL BAIL US OUT? Elec. Light Power, E/G Ed.; 52: No. 3, 14-18(Feb 1974).

Coal must make a comeback, but the general practice in times past has been to use coal when other fuels were not available. Coal production did not increase in 1973. Coal output increase can only be achieved if wildcat strikes and absenteeism stops, mine health and safety harassment subsides, adequate transportation is furnished, price controls abolished, and air pollution laws changed so that sulfur content is disregarded. The coal industry must be assured of a long-term market and iron-clad contracts before new mining is developed. The coal industry needs necessary raw materials to operate at full capacity and this includes diesel fuel, roof bolts for safety, ammonium nitrate for explosives, and a continuing supply of machinery and replacement parts. (MCW)

26398 ENERGY POLICY OF ELECTRICITE DE FRANCE AND THE OUTLOOK FOR THE FUTURE. Spinart, J. (Electricite de France, Paris). Tech. Mod.; 65: No. 10, 19-22(Oct 1973). (In French).

The current situation is presented (net power installed in France on the 1st of January 1973). The role of the EDF and the predicted growth in the demand for electrical energy are given together with the origin of the energy (hydraulic, classical thermal, and nuclear) and the respective roles of primary fuels (oil-fuels, coal, U, etc). (FR)

26399 POWER FROM COAL. II. Combustion and Ash-Handling Practice. Power; 118: No. 3, S25-S48(Mar 1974).

The theory of coal combustion is described. Fuel/air ratios, proper mixing, differences between fuel-bed and suspension firing, basic arrangements at the mill for coal sizing, fineness or quality of mill output, and volatile guidelines are discussed. Ash increases the cost of shipping and handling coal, and its content in coal determines the size and type of ash-handling system. System selection is closely related to ash content, how coal is burned, and amount and type of ash collected. Small plants use exhausters. (MCW)

26400 ENERGY SHORTAGE: A BENIGN CRISIS. Armstrong, E. L. Consult. Eng.; 42: No. 3, 112-116(Mar 1974).

The energy crisis is real and the days of cheap and plentiful energy are gone, perhaps forever. Resources and technology are available to meet the energy austerity. The good evolving from the energy crisis means conservation in many considerations of city planning such as master planning for transportation, water supply, sewers, and utilities; urban construction; and recreation facilities near subdivisions. Urban and suburban areas are evolving from low density residential communities clustering around a well-defined central city to a collection of regional subcenters around the central-city area, each consisting of malls, high-rise office buildings, industrial areas, and apartment complexes linked by belt highways. (MCW)

26401 GAS TURBINE POWER GENERATION: RELIABILITY AND MAINTAINABILITY IN ELECTRIC UTILITY SERVICE. Roberts, W. S. (W. S. Roberts Engineering Co., Indianapolis). Gas Turbine Int.; 14: No. 4, 18-25; 33; 47(1973).

Gas turbine reliability and maintenance were discussed by personnel from Public Service Electric and Gas Company, Newark, New Jersey; Philadelphia Electric Company, Philadelphia, Pennsylvania; and Long Island Lighting Company, Hicksville, New York. Many areas of discussion were presented including such things as avoiding engine-generator mismatch; fuel quality; start-up factors; control systems; lubricating systems; overhaul facilities; inspections; instrumentations; and all accessories. Total energy systems must be considered since exhaust stacks are getting higher, environmental standards changing, and engineering problems encountered due to multiple unit construction. (MCW)

26402 ENERGY PROBLEM AND DEFENSE. Sonenshein, N. Nav. Eng. J.; 86: No. 1, 19-27(Feb 1974).

From Tidewater Section ASNE; Norfolk, Virginia (27 Nov 1973).

Making intelligent use of the available fossil fuels and moving ahead rapidly to develop new energy sources are compelling issues to meet the present energy situation. The situation is not new, since energy experts in government and private industry have been projecting supply constraints and rising costs in recent years. Research on new energy sources, some of it supported by the Department of Defense, as in nuclear power, has been under way since the 1950's. Environmental standards adopted have added a new variable to the energy equation. In late September 1973, the Defense Energy Task Group was established to analyze the energy problem and to determine what action the DOD could take to minimize its effect on defense readiness. The present approach of the Defense Department is to conserve, to requisition only for essential supplies for national defense, and to compensate by seeking to use the naval petroleum reserves to offset requisitions and by directing energy-related R&D to assist in developing alternate energy resources and in improving the efficiency of energy consumption. (MCW)

26403 TOTAL ENERGY FOR TEXAS A AND M. Boyce, M. P.; Redman, J. C.; Bale, Y. S. Gas Turbine Int.; 14: No. 5, 34-41 (1973).

The total energy power plant system at Texas A&M University is described. The natural gas or the fuel oil is used as the original energy source to drive the gas turbine or to boilers which produce the steam necessary to drive the steam turbines. Low pressure steam is extracted from the turbines and used to produce heating water, chilled water, and domestic hot water. The utilities are then distributed throughout the campus to the various buildings. The unused utilities are then returned to the power plant where they are again recycled through the plant and redistributed. (auth)

26404 DESIGNING GAS TURBINE HEAT RECOVERY BOILERS. van den Hoogen, I. B. (Nederlandsche Electrolasch Maatschappij, Leiden). Gas Turbine Int.; 14: No. 6, 32-35(1973).

The low thermal efficiency of the simple cycle gas turbines as compared with conventional steam installations have delayed the extension of the application of these engines. With about 70% of the energy leaving the system through the exhaust gases, methods are needed for recovery of the waste heat that is at a temperature of 400 to 500°C. The oxygen concentration is such that additional firing is possible. Based on these conditions a full range of heat recovery boilers and accessories were developed. Five arrangements of heat recovery machinery are shown of how equipment can be varied to match operating requirements. All steam production and firing rates are based on an exhaust flow of 410,000 kg/hr at 485°C. (General Electric MS-5 gas turbine.) (MCW)

26405 UNITED STATES OIL IMPORTS: IMPLICATIONS FOR THE BALANCE OF PAYMENTS. Frank, H. J.; Well, D. A. (Univ. of Arizona, Tucson). Nat. Res. J.; 13: No. 3, 431-447 (Jul 1973).

The background of the energy shortage, projections of future import requirements by 1980, estimation of the cost of these imports, examination of their probable impact on the U. S. international payments position, and the balance of payments adjustment mechanisms designed to cope with this impact are discussed. The development of domestic energy sources at higher cost will have balance of payments repercussions reflected in the overall cost structure of U. S. industry. (MCW)

26406 HIGHLIGHTS OF A BUSY YEAR FOR COAL. Coal Age; 79: No. 2, 70-3(Feb 1974).

In 1973, 590 million tons of coal were produced. In order to increase the 1974 production to 660 million tons, the following criteria must be attained: labor stability with an end to absenteeism and wildcat stoppages; effective enforcement of mine health and safety laws without harassment or unnecessary mine closures; continue surface mining with reasonable reclamation requirements; adequate rail hopper cars; exemption from price controls of all coal sales; variances in air pollution control regulations to allow burning of available high-sulfur coals; and adequate mine supplies, especially roof bolts, fuels, and explosives. Suitable sites have been selected for coal gasification plants. SNG from coal is expected to be competitive with gas brought by pipeline from Alaska, gas imported as a liquid in cryogenic tankers, and SNG produced from naphtha or other feedstocks. (MCW)

26407 MILLION-TON TANKER FLEET: IS IT REALLY COMING. Spyrou, A. G.; Shimpo, Y. (Olympic Maritime, S. A., Monaco). Oil Gas J.; 72: No. 9, 58-60; 65(4 Mar 1974).

"Probably" says Andrew G. Spyrou of the Olympic Maritime, S. A., A. S. Onassis Group of Companies, Monaco, of the likelihood of the construction of the million-ton tankers. Naval architects are proceeding with designs. Experience with the quarter-tonners gives confidence that the million-tonner is feasible. The International Maritime Consultative Organization (IMCO) in dealing with pollution control has enacted that tankers over 70,000 dwt after 1980 be required to be segregated-ballast-tankers. The price for construction will be almost prohibitive says Y. Shimpo, Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo, so "unlikely", he says. Efficiency is the reason for increased size and this will be minimized due to ship cost, labor, increased insurance costs, and all facilities for building, maintenance, and mooring will be increased. (MCW)

26408 ENERGY CONSERVATION IN EXISTING PLANTS. Robertson, J. C. (Dow Chemical Co., Freeport, TX). Chem. Eng.; 81: No. 2, 104-111(21 Jan 1974).

Measures for energy conservation at Dow Chemical's Texas Division are described. Management formed a Division Energy-Conservation Team to implement and coordinate a plan. A 10% reduction in energy used in 1972 was attained with increased yield. Changes were made in the power and steam-generating cycles and the chemical process designs. Valuable raw materials were recovered; steam was used more efficiently; condensates were recovered; combustion losses were minimized; and electricity and lighting were conserved. (MCW)

26409 ENERGY CONSERVATION IN NEW-PLANT DESIGN. Fleming, J. B.; Lambrix, J. R.; Smith, M. R. (M. W. Kellogg Co., Houston, TX). Chem. Eng.; 81: No. 2, 112-122(21 Jan 1974).

New plant designs will now include new energy-conservation design features, more-stringent safety features, and environmental-protection devices. U. S. process plants have been designed for low capital cost, but with higher operating costs. Nine methods described that engineers are now using to cope with the higher energy costs of the 1975-1980 period are furnace efficiency; power-recovery systems; hydraulic-turbine power recovery; reflux vs operating cost; water cooling vs air cooling; fluid catalytic-cracking unit power-recovery systems; ammonia-plant optimization; ethylene-plant design; and cryogenic gas processing. (MCW)

26410 RECENT DEVELOPMENTS IN SOLAR ENERGY RESEARCH AND APPLICATION IN JAPAN. Noguchi, T. (Government Industrial Research Inst., Nagoya, Japan). Solar Energy; 15: No. 2, 179-187(Jul 1973).

A ten-year review of solar energy research, development, and applications is given. Work on solar energy in Japan has been promoted and given more widespread support since the founding of the Japanese Association for Applied Solar Energy in 1961. Recent developments in the summary include: air pollution, turbidity, and radiation measurement; agricultural applications; solar water heaters; solar power generation; high-temperature solar furnace work; architectural studies associated with solar radiation and environmental hygiene; and solar simulation. (70 references) (auth)

26411 PLANNING FOR PRODUCTION OF SYNTHETIC HYDROCARBON FUELS. Whiting, J. M. (Bank of Montreal). Mining Congr. J.; 60: No. 2, 51-60(Feb 1974).

From 1970 through the year 2000 it is projected that the U. S. and Canada demand will be 4420 Q Btu of energy. The continental resource availability of domestic crude oil, natural gas, coal, oil shale, and oil sands is considered. Three development programs are presented for coal gasification, oil sands, and oil shale, each of which would develop an energy output equivalent to four million bbl/day of oil by 2000. (MCW)

26412 MANY VARIABLES GO INTO PLANNING DEEPWATER TERMINAL. Dudley, R. J.; Havik, K. P. Oil Gas J.; 72: No. 9, 53-57(4 Mar 1974).

Plans for a safe and successful deepwater seadock in the United States are proceeding. Waterborne transportation will be the means for transporting the long-term oil-import requirements. Many seacoast areas are being considered and data are being compiled on wind, waves, currents, tidal movements, water depth, sea-bottom topography, and soil conditions; assessments of availability of maneuvering and anchoring areas and approach lanes, especially in relation to other ship traffic or other activities such as oil and gas exploration and production; studies of possible impacts on the environment, and economy of the regions. (MCW)

26413 WORLD OIL OUTPUT JUMPS 9.5% IN 1973. Auldridge, L. Oil Gas J.; 72: No. 8, 34; 36-37(25 Feb 1974).

World crude-oil production set a new record in 1973 with the production of about 55.5 million bbl/day. World production reached its monthly peak for the year in September. Even with the Middle East disturbance, Saudi Arabia showed a 26.4% increase for 1973. Regional production analyses for 1973 are shown for Canada, Europe, Communist Area, United States, Latin America, Africa, Asia-Pacific Area, and the Middle East. (MCW)

26414 DRIVE FINALLY BUILDING IN U. S. TO DEVELOP OIL SHALE. West, J. Oil Gas J.; 72: No. 8, 15-19(25 Feb 1974).

The U. S. will be producing about 1 million bbl/day of shale oil generally regarded as a mature level of development, in the 1980's barring problems with technology, capital, manpower, availability of federal leases, and environmental concerns. Geologists believe shale-oil deposits in the Tertiary Green River formation in the tristate region of Colorado, Utah, and Wyoming hold promise for commercial production. Many oil companies are exploring in northwestern Colorado's Piceance Basin. Plans for all the oil companies are told, but Superior Oil Co. believes its plant could produce low-sulfur No. 6 fuel oil, nahcolite, aluminum compounds, and sodium carbonate. Nahcolite may be converted to soda ash and used in conjunction with a particulate-removal device to scrub stack gas to meet environmental controls. (MCW)

26415 PETROLEUM POTENTIAL OF ARCTIC CANADA. Rudkin, R. A. (R. A. Rudkin Consultants Ltd., Calgary, Alberta). Oil Gas J.; 72: No. 10, 145-152(11 Mar 1974).

Drilling of 50 wells on the land area north of the Aklavik arch has produced mainly gas with some light oil or condensate. Oil was discovered in fault traps along the northern edge of the arch. Offshore drilling has begun, but it appears that the oil reserves discovered to date do not meet the threshold volume necessary for an oil pipeline. It is estimated that about 15 Tcf of gas has been discovered in the Beaufort Basin and does meet the threshold volume to justify a pipeline to Alberta. The geology of the Beaufort Basin is described. Arctic Islands oil will possibly be delivered to market by pipeline by 1985 and gas by 1983. (MCW)

26416 EXPERTS VIEW IMPROVED RECOVERY STATUS. Bleakley, W. B. Oil Gas J.; 72: No. 10, 85-88; 90(11 Mar 1974).

Estimates are made that improved oil-recovery methods must account for ⅓ to ½ of the U. S. future oil production. Six oil men participated in a panel discussion on how to reach that goal facing major and independent oil companies. Special significance was given to tertiary oil recovery. (MCW)

26417 ENERGY CONSERVATION BEING PUSHED HARD. Wett, T. Oil Gas J.; 72: No. 10, 67-72(11 Mar 1974).

Energy conservation is being practiced in petrochemical industries and teams have been established to plan the programs and projects. Dow Chemical, Du Pont, American Cyanamid, BASF Wyandotte, Union Carbide, Exxon Chemical, and Goodyear are companies reporting energy-reduction programs in power generation, process changes, steam savings, using wastes, waste stream sales, furnace and flue gas savings. (MCW)

26418 MANDATORY OIL IMPORT QUOTA PROGRAM: A CONSIDERATION OF ECONOMIC EFFICIENCY AND EQUITY. Cicchetti, C. J. (Univ. of Wisconsin, Madison); Gillen, W. J. Nat. Res. J.; 13: No. 3, 399-430(Jul 1973).

The historical development of the Mandatory Oil Import Quota Program is reviewed, and the manner in which it functions is described. Several analyses made during and shortly after the Cabinet Task Force Report are reviewed, and these are updated to reflect changing market conditions. Finally, the equity and efficiency aspects of the program are analyzed in the context of its objectives, and alternative means of achieving those objectives are considered. (MCW)

26419 SOLAR ENGINE USING THE THERMAL EXPANSION OF METALS. Beam, R.; Jedlicka, J. (Ames Research Center, Moffett Field, CA). Solar Energy; 15: No. 2, 133-142(Jul 1973).

A thermal engine with solid metal (stainless steel-304) as the single-phase working substance is described. The engine can consist of nothing more than a metal tube mounted in a bearing at either end so that it is free to rotate about its axis, with a flywheel mass at its midpoint. When the tube is heated on its upper surface, the region of its maximum compressive bending stress, it will rotate and produce steady power. Compared to engines using a gas or a liquid as the working substance, this engine has the disadvantage of low thermal efficiency but the advantage of simplicity. The solid metal phase engine may be useful for converting solar energy into small amounts of mechanical energy in underdeveloped regions of the world. (auth)

26420 APPLICATIONS OF IDENTIFICATION METHODS IN POWER GENERATION AND DISTRIBUTION. Baeyens, R.; Jacquet, B. pp 1107-1121 of Identification and Systems Parameter Estimation. II. Eykhoff, P. (ed.). Amsterdam; North-Holland Publishing Co. (1973).

From third identification and system parameter estimation symposium; The Hague/Delft, Netherlands (12 Jun 1973). See CONF-730676-P2.

The application of identification methods in power plants and networks is complex and generally one mathematical analysis does not suffice. The survey specifies the nature of processes in power generation. Identification methods in power generation and transport are used often to design control systems, for forecasting problems, and in improvement of the processes. Methods applied include deterministic methods, methods using correlation functions or spectral analysis, and parametric methods. 121 references. (MCW)

26421 SYSTEM OPTIMIZATION AND ENERGY CONSERVATION FOR LOS ANGELES MEGASTRUCTURE. Ayres, J. M.; Sun, T. Y. (Ayres and Hayakawa, Los Angeles). Heat., Piping Air Cond.; 46: No. 1, 60-63(Jan 1974).

Broadway Plaza in Los Angeles covers 4.5 acres with shopping, office, and hotel facilities within a single structure. Emphasis was placed on system optimization, energy conservation, and life safety in the computer-aided design for the plaza. The entire structure is described with its environmental engineering in all areas. (MCW)

26422 TURBINE TOTAL ENERGY FOR OFFSHORE RIGS. Wittner, B. R.; Culp, R. E. (North American Turbine Corp., Houston, TX). Gas Turbine Int.; 14: No. 6, 14-18(1973).

The advantages of prepackaged gas turbine powered total energy systems for remote operations are outlined. These include space savings, favorable weight/power ratios, vibrationless operation, recoverable exhaust energy, and cleaner exhaust. Major system components and economics are discussed for systems of the 3 to 6 MW capacity. (MCW)

26423 PROCESS FOR A COAL GASIFICATION. Ban, T. E. (to McDowell-Wellman Engineering Co.). US Patent 3,787,192. 22 Jan 1974. Filed date 2 Mar 1972. 6p.

A process is described for producing water gas containing a large quantity of hydrogen and involving the formation of a moving quiescent gas-permeable bed composed of both particles of coal and particles of spent coal or ash. The bed is passed through a series of zones in which, in a succession of cycles, the bed is permeated with an oxygen-containing gas preheated to a predetermined temperature and then a moisture-laden gas also preheated to a predetermined temperature. These gases are collected separately after they traverse the moving quiescent bed. The water gas may be used as an industrial gas, and the product-flue gas resulting from the portions treated with oxygen-containing gas may be recycled through the bed at a point downstream. The process provides a continuous economic procedure for gasification of coal. (Official Gazette)

26424 CAN NUCLEAR ENERGY COMPETE WITH NATURAL GAS: RESULTS OF A COMPARATIVE ANALYSIS. Hondius, H. (Nederlandse Gasunie, Groningen). Atomwirt., Atomtech.; 18: No. 11, 514-517(Nov 1973). (In German).

In 1969, Nederlandse Gasunie commissioned the American engineering contractor Ebasco Services Inc. to carry out a study to determine the acceptable price for natural gas used in electricity generating plants competing with nuclear stations of comparable size. The starting point was a nuclear power station consisting of two units, to be commissioned 1/6/75 and 1/6/76, with block sizes of 600 MW and 800 MW, respectively. The capital costs were determined by means of models and the kWh price calculated. At the same time a power station fired with natural gas or with natural gas/fuel oil was planned and its capital costs determined. Using similar conditions for the calculation, the price of natural gas required to give the same price per kWh in the fossil fuel station as that in the nuclear station was computed. In 1971, Ebasco obtained a follow-up contract to bring the study up to date in terms of commissioning times of 1/6/77 and 1/6/78 for the two units. This adapted study, whose parameters are described in detail, showed that for the block sizes considered the gas-fired installation is the more advantageous with the present favorable Dutch price of 8 Dfl/Gcal for natural gas. Nuclear stations supplying a basic load with capacities of 1,200 MW could be competitive by 1980. In addition the natural gas provision does not allow for further natural gas contracts being concluded for new basic load power stations going into operation after 1977. (GE)

26425 RESEARCH ON THERMAL BEHAVIOR OF OIL SHALES. Nistor, I.; Barca, F.; Cernica, E.; Bidulescu, A. Stud. Cercet. Energ. Electroteh.; 23: No. 4, 911-917(1973). (In Rumanian).

For the characterization of the thermal behavior of the organic and inorganic mass of oil shales research was carried out with the aid of a derivatograph on the material itself and on the residuum resulting from the extractions with pyridine and quinoline in oxidizing, reducing and inert medium. The exothermal and endothermal zones and resulting weight losses were determined. The correlation of the experimental data shows that the oil shale burning takes place in a relatively low temperature domain. (tr-auth)

26426 GREAT COAL RUSH OF THE 1970's. Environ. Sci. Technol.; 8: No. 3, 208-209(Mar 1974).

The American Petroleum Institute issued warnings on an impending fuel problem in 1954. Fossil fuels were still used at record rates. In 1973, the federal government requested some power plants to switch from oil to coal. The switch to coal-fired boilers is expensive and then the added expense of pollution control equipment for particulate matter, sulfur and nitrogen oxides produced from coal combustion puts hardships on the utilities. New plants are utilizing designs for dual-fuel boilers. Coal is basically still plentiful in the U. S. and new methods are being developed to make cleaner burning fuels and useful chemical by-products from coal. The use of coal would produce self-sufficiency of the U. S. for its energy needs. (MCW)

26427 TWO-STAGE GASIFICATION OF COAL WITH FORCED REACTANT MIXING AND STEAM TREATMENT OF RECYCLED CHAR. Donath, E. E. (to Secretary of the Interior). US Patent 3,782,913. 1 Jan 1974. Filed date 23 Mar 1972. 8p.

Methane-rich fuel gas is produced by a two-stage gasification process wherein particulate coal and steam are reacted in the second stage with synthesis gas from the first stage at temperatures in excess of 1600°F and pressures in excess of 50 atmospheres to produce char and a product gas containing hydrogen, methane and oxides of carbon. The char and product gas are withdrawn and separated and the product gas is thereafter treated to remove carbon oxides and other diluents and is ultimately methanated to produce a methane-rich fuel gas. The char is recycled to the first gasification stage for reaction with steam and oxygen at temperatures in excess of 2500°F and pressures in excess of 50 atmospheres to produce a synthesis gas containing hydrogen and oxides of carbon for reaction in the second gasification stage. A portion of the char, which has low-sulfur content, can be burned to produce process energy. Ash produced from the reactions in the first and second stages gravitates, at least partially as molten slag, to the lower sections of the reactor in stage one where the ash and slag are cooled and removed from the process. (MCW)

26428 OPTIMIZING THE CLEAN ENERGY REFINERY. Heat Eng.; 46: No. 3, 33-37(1973).

The Process Plants Division of Foster Wheeler constructed a general computer model of a clean energy refinery that produces no products other than low-sulfur gaseous and liquid fuels that can be used in conformance with all government standards regarding the combustion of fuels in industrial and residential services. The REFOP complete linear programming system has the capability of setting up and optimizing any petroleum or petrochemical processing complex. A schematic block diagram is shown of the model using the effects of crude and SNG prices on the economics of a hypothetical 150,000 bpsd facility. (MCW)

26429 ENERGY CONCEPTS FOR NEW ERA. Heat Eng.; 46: No. 5, 65-80(1973).

The utilization of waste heat and waste fuel means increased efficiencies and a cleaner environment. Some developments for the reclamation of waste fuels and waste heat at Foster Wheeler Limited are discussed. Refuse-fired boilers that have bark-burning equipment as an integral part of the main furnace are described. Not only waste fuels from the forest industry may be applied, but also bagasse from sugar cane, pits from olives, coconut shells, and husks and chaff from milling of grain. The shop-assembled wood and fibrous fuel-fired boilers are described. Flue gases discharged to the atmosphere are being reclaimed and the use of by-products such as CO and refinery coke are being used as fuel for steam generators. Some currently employed heat recovery schemes and the selection of suitable equipment are reviewed. (MCW)

26430 LONGANNET: THE UNITED KINGDOM'S LARGEST POWER STATION. Heat Eng.; 46: No. 4, 49-57(1973).

Longannet Power Station is on the Forth Estuary, twenty miles from Edinburgh. The Hirst coal seam with considerable reserves of low-grade coal suitable for large pulverized fuel boilers is nearby. The physical characteristics of the plant are described. The four identical steam generators were designed, manufactured, and erected by Foster Wheeler John Brown Boilers Limited. Longannet fits into the environment; the attractive and functional buildings are clad with glazing color-coated steel sheeting above a dark blue base. (MCW)

26431 STATISTICS OF ENERGY, 1957-1971. Paris; Organization for Economic Cooperation and Development (1974). 257p. (In English and French). $6.75.

A set of basic statistics on production, trade, consumption, etc. for each source of energy are assembled in the manual for economists and others concerned with energy problems in the OECD countries. Part One shows trends for each principal source of energy from 1957 to 1971 for the OECD as a whole and for each of the three main OECD areas. Part Two relates to the situation in 1969, 1970, and 1971 for all sources of energy in each OECD country and in the five groups of OECD countries. (MCW)

26432 ENERGY UNDER THE OCEANS. A Technology Assessment of Outer Continental Shelf Oil and Gas Operations. Kash, D. E.; White, I. L.; Bergey, K. H.; Chartock, M. A.; Devine, M. D.; Leonard, R. L.; Salomon, S. N.; Young, H. W. Norman, OK; University of Oklahoma Press (1973). 397p. $20.00.

The technology assessment of the U. S. outer continental shelf oil and gas operations is an attempt to introduce all consequences well beyond the conventional considerations of economic costs and benefits or immediate implications for the perpetrator or user of technology. The assessment study attempts to inform the interested public and the decision-makers of the possible ranges of consequences of new actions. An examination was made of the development of outer continental shelf oil and gas resources and how policies are currently established. Topics are discussed such as the adequacy of present technologies, the quality of environment and environmental control, government management, and federal and state jurisdiction. Then recommendations are given regarding government policy and administration, industry management, and technologies that will contribute to optimal resource development. (MCW)

26433 POWER FROM COAL. I. Coal Selection and Handling. Power; 118: No. 2, S1-S24(Feb 1974).

The basics of selection and key facts about coal and the equipment and methodology of coal handling are discussed. It is indicated that it will take years to gain momentum in coal development. The first requisite for coal development is to know its availability, and then an analysis is essential. The characteristics of coal discussed include moisture, ash, volatile matter, fixed carbon, and sulfur content, ash-fusibility temperature, heating value, and all their related properties. Dust suppression and transportation of coal are discussed. In-transfer operation, bucket elevators, continuous-flow conveyor, and belt conveyors were described for unloading coal. (MCW)

26434 ELECTRICITY: A VITAL FORCE FOR VIGOROUS GROWTH. Garvin, D. F. Pub. Util. Fortn.; 93: No. 5, 29-41 (28 Feb 1974).

Energy is utilized in nearly every economic activity of man and is shown in such relationships as construction expenditures and pollution control. Utility growth, economics, and production considerations are described. Exploration and development of raw materials in the US must continue with emphasis on the abundant coal resource. The view is expressed that electrical facilities must continue to be built. Electric power was responsible for 26% of the nation's total energy consumption in 1970 and is projected to grow to 42% by the year 1990. (MCW)

26435 WALTZ MILL FACILITY TESTS UNDERGROUND CABLES AND ALSO DEMONSTRATES FEASIBILITY OF 1100-kV OVERHEAD SYSTEMS. Baldwin, C. J.; Bankoske, J. W. (Westinghouse Electric Corp., East Pittsburgh, PA). Westinghouse Eng.; 33: No. 6, 180-185(Nov 1973).

The Waltz Mill facility serves for accelerated testing of sample insulation and other evaluations that require a continuous high voltage, circulating load current, and computerized temperature and process control. The area is divided into a high-voltage test area where controlled three-phase voltage up to 345 kV is available, and an extra-high-voltage test area where control three-phase voltage up to 1100 kV is available. Testing of four 550-kV underground cable systems was performed in the EHV area. The system will be subjected to higher voltages and temperatures to establish their capability with 800 kV as a prime objective. Computers were developed for the management of accelerated life testing of cable samples. The four general types are data collecting and processing, alarming and detection of abnormal conditions, reports, and control programs. Dielectric dissipation factor values verify the performance of paper-insulated cables and a transformer ratio-arm bridge is used for these measurements. Partial discharge measurements on solid-dielectric cables are recorded with a differential corona bridge. The measuring procedures are described. (MCW)

26436 CONTROL OF ENERGY DEMAND REDUCES PLANT OPERATING COSTS. Murphy, B. H.; Putman, R. E. (Westinghouse Electric Corp., Pittsburgh). Westinghouse Eng.; 34: No. 1, 10-15(Jan 1974).

The use of a Westinghouse demand control system (W-2500 computer) is described to reduce the demand charge placed on the use of electricity and gas. Demand charge is the utility's charge for the maximum rate of energy usage in addition to its charge for the total amount of energy used. Energy demand is reduced by prohibiting simultaneous operation of large energy-consuming devices, or by deferring the use of such equipment as air conditioners from one demand period to another. The computer is applied to select loads in accordance with established data. Electric power demand profiles for three actual manufacturing plants are illustrated. (MCW)

26437 ENERGY CRISIS ALTERS POWER-USE PATTERN. Elec. World; 181: No. 1, 64-65(1 Jan 1974).

The energy crisis and the resulting energy conservation measures practiced make utility load forecasting difficult. Stone and Webster Management Consultants performed a survey and it is concluded that in the residential sector, natural-gas curtailments have made a significant dent in gas-appliance sales. Electric appliances maintained their strong growth for the first half of 1973. Regional differences show up in the survey of industrial energy needs. Energy conservation measures were established for a manufacturing plant by the electric utility company serving it. (MCW)

26438 GAS-TURBINE RETROFIT PAYS DIVIDENDS. Smith, A. J. (Power Systems Engineering Inc., Houston, TX). Elec. World; 181: No. 2, 62-63(15 Jan 1974).

The addition of a heat recovery combined cycle to open-cycle peaking gas-turbine installations features the recovery of the energy in the hot-air exhausts. Generating capacity may be increased by 50 percent and they require no additional fuel. Other advantages include: reliability; air pollution is related to total power generation and is reduced by one-third; requirements for less sophisticated control systems; maintenance costs are minimal; and operation of the system may be essentially automatic. Practically any existing gas-turbine unit may be converted, or repowered. The steam turbine would be located nearby, but not necessarily adjacent to the gas turbine. (MCW)

26439 DESIGN EHV LINES TO REDUCE IMPACT. Byron, R. A. (American Electric Power Service Corp., New York). Elec. World; 181: No. 2, 74-77(15 Jan 1974).

The development of increased EHV power transmission lines from the 1940's when 138 kV was common is traced. Experience from development of the 287-kV Boulder Dam-Los Angeles project and the Tidd 500 kV project, resulted in conclusions that indicated that high-voltage lines and equipment could be smaller than previously estimated. American Electric Power had about 2,720 circuit miles in operation of 345 kV in service in 1973. A research facility at Apple Grove, W. Va. was built to investigate voltages to 775 kV. Radio interference, television interference, audible noise, gaseous effluents, and electrostatic induction are the most prominent environmental effects. Physical environmental constraints are mapped and evaluated for an area before the construction of an EHV system. Siting legislation has been passed in Virginia, West Virginia, and Ohio. (MCW)

26440 ECONOMICS OF RESOURCE RECOVERY FROM MUNICIPAL SOLID WASTE. Abert, J. G.; Alter, H.; Bernheisel, J. F. (National Center for Resource Recovery, Washington, DC). Science; 183: No. 4129, 1052-1058(15 Mar 1974).

Based on the composition of the refuse stream, recovery is essentially a two-phase process: materials recovery of glass, metals, and some paper and recovery of the organic portion and reuse through conversion, probably as a source of energy. Schemes are shown of front end recovery referring to materials recovery with disposal of the organic portion by conventional means and back end recovery referring to the recovery of the organic portion and its reuse as fuel or as raw material for a product. An analysis was made based on the assumption that the value of the fuel recovered exactly offset the additional capital and operating costs of the utility that burns it. Costs could sway either way, but it is assumed that the materials-plus-energy case seems realistic. (23 references) (MCW)

26441 CONTRIBUTION OF MATERIALS TECHNOLOGY TO POWER GENERATION. Gemmill, M. G. (Central Electricity Generating Board, Cheltenham, Eng.). J. Test. Eval.; 21: No. 1, 3-13(Jan 1974).

The scientific principles governing metal behavior are considered in regard to creep, fracture, and corrosion processes as they relate to the successful development of materials for high temperature engineering applications. In the past decade the emphasis in the design and development of land power plants has shifted from the aim of higher thermal efficiency to one of greater plant component reliability. This has brought about a corresponding need to understand existing materials more thoroughly, rather than to seek new material compositions. The consequence of this will be examined in the context of fossil-fueled boilers, nuclear reactors of various types, and steam and gas turbines. (auth)

26442 EXPERIENCE WITH THE AEP 765-kV SYSTEM. II. System Performance. Maliszewski, R. M. (American Electric Power Service Corp., New York). IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst.; PAS-92: No. 4, 1337-1347(1973).

The system performance aspects of AEP's experience with its 765-kV transmission network are discussed. The first segment of this network was energized in May 1969. Since that time, a total of 670 miles of 765-kV transmission has been placed in operation. The experiences accumulated thus far with bringing segments of 765-kV transmission into service, as well as with real and reactive power flow, reactive compensation and supply, voltage control, and 765-kV equipment spare requirements are reviewed. (auth)

26443 DYNAMIC MODELS FOR STEAM AND HYDRO TURBINES IN POWER-SYSTEM STUDIES: IEEE COMMITTEE REPORT. IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst.; PAS-92: No. 6, 1904-1915(1973).

Basic models for speed-governing systems and turbines in power system stability studies are presented. These models provide adequate representation for hydro, fossil-fired, and pressurized-water reactor nuclear units in most stability analyses. Models for boiling water reactor nuclear units are to be presented at a later date. Typical parameters are given. (auth)

26444 OPTIMAL CONTROL OF A HVDC TRANSMISSION LINK. Sachdev, M. S.; Fleming, R. J.; Chand, J. (Univ. of Saskatchewan, Saskatoon). IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst.; PAS-92: No. 6, 1958-1965(1973).

The modern control theory is applied to design HVDC controllers. The state regulator and tracking techniques were used to design controller feedbacks to improve system performance. Both optimal and sub-optimal controllers were designed. An "eigenvalue search" technique was also applied to determine the desired controller gain and time constant. Using the various designed controllers, the dynamic performance of the system was studied on both a digital computer and a small scale simulator. Some of these time domain studies are included in addition to the root locus plots. (auth)

26445 EFFECTS OF EARTH RESISTIVITY ON MODAL PARAMETERS OF AN EHV HORIZONTAL LINE AT PLC FREQUENCIES. Perz, M. C.; Hazel, R. L. (Univ. of Windsor, Ont.). IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst.; PAS-92: No. 6, 2044-2052(1973).

A brief comparison of the salient aspects of modal analyses of lossless and lossy lines is described. Simplified equations for modal parameters of a three-phase horizontal line are demonstrated. Effects of Earth resistivity, ρ_s, on the modal attenuations and velocities of propagation on a 500-kV line are discussed for ρ_s from 20 Ω-m to 2000 Ω-m at three frequencies, F: 50 kHz, 100 kHz and 200 kHz. Modal voltage components, general and modal reflection-free line terminations are derived and compared with those for the lossless line. It is found that angles of all modal complex parameters and of line terminations are small. (auth)

26446 CONVERTER TRANSIENTS CAUSED BY SWITCHING-TYPE SURGES ON THE DC LINE. Arrillaga, J.; El-Batal, S. (Univ. of Manchester, Eng.). IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst.; PAS-92: No. 5, 1713-1722(1973).

A complete model of a typical HVDC converter station suitable for fast transient studies is used to investigate the effect of the converter termination on switching-type surges coming from the dc line. The surge transfer to the converter side of the dc-reactor and the surge distribution within the converter plant are also investigated. Finally, a dynamic model is used to calculate the surge transfer stresses during current extinction following a switching surge. (auth)

26447 DIELECTRIC TESTS AND TEST PROCEDURES FOR EHV TRANSFORMERS PROTECTED BY MODERN SURGE ARRESTERS AND OPERATED ON EFFECTIVELY GROUND SYSTEMS 345 THROUGH 765 kV. IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst.; PAS-92: No. 5, 1752-1762(1973).

The shortcomings of the existing standard dielectric test procedures for EHV transformers are stated. Proposals are made to correct the shortcomings. The proposals include dissociating the low-frequency test voltage requirements from the transient test voltage requirements, and relating each test independently to corresponding operating conditions. Impulse and switching surge tests are related to the characteristics of the protecting surge arrester. Low-frequency tests are related to operating voltages. The duration of the low-frequency test is increased, and the magnitude is reduced. The transformer is connected, for the test, as it is connected in service. Continual monitoring of corona is recommended. The objective of the proposals is improved operating reliability by specifying tests that are more compatible with service requirements. Examples are given. (43 references) (auth)

26448 OPERATION OF SENECA PUMPED STORAGE PLANT. Fitzgerald, J. P. (Cleveland Electric Illuminating Co.); Cooper, E. A.; Solomon, F. P. IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst.; PAS-92: No. 5, 1510-1516(1973).

The Seneca pumped storage plant has been in commercial service since January 14, 1970. Synchronous starting of large reversible generator/motors by means of a small generator has proved to be highly reliable and the overall efficiency of the station ranges from 71 to 79 percent. Design modifications made since start-up are described. (auth)

26449 INDUCTIVE TEST CIRCUIT FOR A FAST ACTING HVDC INTERRUPTER. Hofmann, G. A.; Long, W. F.; Knauer, W. (Hugh Research Labs., Malibu, CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst.; PAS-92: No. 5, 1605-1614(1973).

A unique test facility utilizing the inductive energy storage principle has been constructed in order to examine the characteristics of a fast acting HVDC interrupter. The facility is capable of producing currents up to 10,000 A, developing voltages up to 200 kV, and storing energies up to 125 kJ. It is able to closely simulate the operational stresses encountered in the interruption of dc current. Experimental and computer results illustrate the operating characteristics of the facility. (auth)

26450 VALVE-DAMPING CIRCUIT DESIGN FOR HVDC SYSTEMS. Beausejour, Y. (Univ. of Quebec, Varennes); Karady, G. IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst.; PAS-92: No. 5, 1615-1621(1973).

A method is presented of calculating the recovery overvoltages in a HVDC circuit and the optimization of the damping circuit by selecting the lowest value of the damping circuit capacitance and the resistance that together satisfactorily limit the recovery voltage. Furthermore, a new method is developed for exact calculation of the losses in the damping circuit using a hybrid computer. The effect of the bridge operation (commutating and delay angles) and damping circuit parameters on the losses are analyzed using numerical examples. Finally, a method for designing the valve damping circuit is presented. (auth)

26451 NUCLEAR ENERGY: THE SOURCE FOR THE FUTURE. Lewis, W. B. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Naturwissenschaften; 60: No. 11, 501-506(Nov 1973).

Following an estimate of the future energy needs of the whole world, a survey is given of future processes of nuclear energy conversion, taking the CANDU reactor currently most used in

Canada as a reference basis. The following types of conversion methods are reviewed: fast breeders, thermonuclear energy sources, neutron sources, and fusion reactors. (UA/OB) (GE)

26452 INNOVATION AND PRODUCTIVITY IN 1974: IS ANYBODY PAYING ATTENTION IN AN ENERGY-DOMINATED ERA. Kane, J. T. Prof. Eng.; 44: No. 1, 24-28(Jan 1974).

Problems of technology innovation and productivity in the U. S. are summarized. Energy economics and availability are tied to all facets of U. S. industry. A study by Arthur D. Little, Inc. on the barriers to innovations in industry indicates that barriers relate to marketing issues, finance, corporate organization, the impact of government policy on industry, and also to the lack of seed capital for starting new high-technology businesses. A broad range of barriers to innovation related to the problem of patents exists. It is recommended that government regulatory agencies help overcome barriers to innovation in industry. (MCW)

26453 HIGH-PERFORMANCE GLASSES FOR ENERGY-EFFICIENT BUILDINGS. Malarky, J. T. Prof. Eng.; 44: No. 2, 23-27(Feb 1974).

Tinted glasses accomplish environmental control by means of selected metallic oxides added in small amounts to the basic soda-lime-silicate glass formula. The characteristics of a representative office building in Pittsburgh, Pa. were used to determine the effect of glass on energy consumption. Three architectural glasses were evaluated and it was concluded that glass in exterior walls saves energy during heating or cooling. Calculations were made for $\frac{1}{4}$-in. clear glass, 1-in. bronze insulating glass, and 1-in. reflective insulating glass. Glass is also a good building material choice in regard to the amount of energy needed for its production. (MCW)

26454 MANAGEMENT AND ECONOMICS IN THE OIL INDUSTRY: A REVIEW. Glenn, W. E. J. Petrol. Technol.; 25: 1342-1346(Nov 1973).

In the late 20th century and up until the 1930's, the new uses for petroleum kept supply vs demand or consumption essentially balanced. The balance was destroyed when oil was discovered in East Texas, and the increased supply gave birth to a new technological era. Conservation or the prevention of physical and economic waste was a prelude to understanding reservoir mechanics and to the great push to optimize production economics. Conservation, well logging, secondary recovery including waterflooding and pressure maintenance by water or gas injection, numerical analyses of such parameters as costs or offshore risks, drilling and completions, automation, offshore drilling, and economics are discussed. (MCW)

26455 THERMODYNAMIC PROPERTIES OF COMPRESSED GASEOUS METHANE. Harrison, R. H.; Moore, R. T.; Douslin, D. R. (Bartlesville Energy Research Center, OK). J. Chem. Eng. Data; 18: No. 2, 131-134(Apr 1973).

Real gas thermodynamic properties, $H-H^\circ$, $S-S^\circ$, and $G-G^\circ$, of methane were determined as functions of temperature (0 to 350°C) and molal density (0.75 to 12.5 mol dm^{-3}) over a pressure range of 0 to 400 atm. These properties are recommended as standards for the development of equation of state relations, since the analytical and graphical correlating techniques produced results that reflect all the inherent accuracy of the basic data. (auth)

26456 COMMERCIAL PRODUCTION OF ^{238}Pu PLANNED. Roach, K. E. (Southern Nuclear Engineering Inc., Dunedin, FL); Rock, B. J.; Thielke, N. R. Elec. World; 181: No. 1, 42-44(1 Jan 1974).

Plutonium 238 is suitable to fuel radioisotope power generators. It has a long half-life, a reasonably high radioisotopic power, a high melting point in ceramic compound form (2,250°C), and as an alpha emitter, minimal shielding requirements. It is applicable in space requirements, nuclear batteries for heart pacemakers, and the energy source in artificial hearts. The study shows that plutonium-238 production in commercial light water reactors is practical. Neptunium-237, produced during routine power operations, is recovered during fuel reprocessing and reinserted into an operating reactor where it undergoes irradiation and is converted to ^{238}Pu. (MCW)

26457 LIABILITIES INTO ASSETS. Environ. Sci. Technol.; 8: No. 3, 210-211(Mar 1974).

Europe has experienced using solid refuse as fuel for decades. The experiences in Amsterdam and Germany are discussed. In the U. S., if the heat energy in the refuse were converted entirely for the production of electricity, it could produce 10% of electric energy produced from conventional steam generation equipment in 1970. The direct burning of refuse for the release of heat and then steam as in the European experience, has been practiced in St. Louis, Mo. and Lynn, Mass. Other projects are going from trash to fuel, as at Tarrytown, N. Y. and Stamford, Conn. In Baltimore, Md., San Diego, Calif., and Charleston, S. C. facilities are in use that convert refuse to a fuel gas by pyrolysis. In East Bridgewater, Mass. the plant derives solid fuel from solid wastes. This Eco-fuel will generate as much steam as pulverized coal on an equal weight basis when fired in a double-vortex burner. (MCW)

Information Handling

26458 NUCLEAR-COMPONENT DATA SYSTEMATIZED. Haueter, R. L. (Consumers Power Co., Jackson, MI). Elec. World; 181: No. 3, 39-42(1 Feb 1974).

A national Nuclear Power Reactor Data System (NPRDS) was developed and engineering and failure data will be collected from all nuclear power plants on certain safety-related systems and components. A subcommittee with members from private and public electric utilities, reactor vendors, and AEC was established to oversee the administration and operation of the NPRDS. A pilot program was initiated at seven nuclear power plants in 1973. Reliability, or failure-rate, statistics for safety-related components and systems will be made readily available by the data system. It is capable for expansion to reactor systems not now in operation. (MCW)

26459 COMMERCIAL NUCLEAR-DATA NETWORK LAUNCHED. Nail, J. H. (Nuclear Assurance Corp., Atlanta). Elec. World; 181: No. 3, 42-43(1 Feb 1974).

Nuclear Operations Reliability Assistance Network (NORAN) is a communications/information concept designed for the nuclear-power industry and offered commercially by the Nuclear Assurance Corp. NORAN is oriented toward timely retrieval of extensive nuclear power plant performance information to determine such things as failure rates, to indicate areas where plant design should be reviewed, and as a diagnostic tool to locate relevant industrial experience when a utility encounters a problem for the first time. NORAN's purpose is to improve communications on significant events, to give timely and direct access to computerized files of such events, and to assist a utility in fulfilling its data-reporting requirements. (MCW)

Law

26460 STRATEGIES FOR INTERNATIONAL ENVIRONMENTAL ACTION: THE CASE FOR AN ENVIRONMENTALLY ORIENTED FOREIGN POLICY. Coan, E. V.; Hillis, J. N.; McCloskey, M. Nat. Res. J.; 14: No. 1, 87-102(Jan 1974).

Environmentalists have voiced concern that the integrity of the global environment is threatened by population growth, the overexploitation of both renewable and nonrenewable resources, by unthinking technological innovation, and by disruption of ecosystems as a result of unplanned growth and military adventurism. Steps have been taken at the level of international cooperation as the result of the Stockholm Conference on the Human Environment, the recent bilateral convention on the Great Lakes, the multilateral conventions on Ocean Dumping, the World Heritage Trust, Endangered Species, and Wetlands, and the environmental agreement between the U. S. and the USSR. Many examples of agreements made to improve and protect the environment are given. The U. S.'s impact on the world's environment demands that a variety of unilateral measures be undertaken from new regulations on exports and imports to a basic reorientation of foreign policy. (MCW)

26461 LEGAL BASES AND BACKGROUND OF THE X-RAY DECREE INCLUDING A GENERAL SURVEY OF THE EXISTING REGULATIONS. Lukes, R. (Univ., Muenster, Ger.). (1973). vp. (In German).

From 14th annual meeting of the Vereinigung Deutscher Strahlenschutzaerzte eV; Wuerzburg, Germany (16 Nov 1973).

The author analyzes the background of the x-ray decree, referring to the increasing governmental efforts to reduce the danger to life and health of the population as well as to goods, caused by x-ray equipment and installations. The paragraphs dealing with the attitude towards living persons and those dealing with the requirements for equipment and installations are reviewed and commented on. (GE)

26462 ORDINANCE RELATING TO PROTECTION FROM THE HARMFUL EFFECTS OF X-RAYS (X-RAY ORDINANCE: RoeV) OF MARCH 1, 1973 (BGB1 I S. 173). Krebs, A. (Bundesministerium fuer Jugend, Bonn). Z. Naturforsch.; 28: No. 9-10, 523-532(Sep 1973). (In German).

Management

26463 (CEA-CONF-2467) RADIOPROTECTION AND SAFETY. Bocquet, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). [nd]. 7p. (In French). (CONF-730677-1). Dep. NTIS (U. S. Sales Only) $3.00.

From 8th congress of the association of radioprotection technicians; Chatenay-Malabry, France (8 Jun 1973).

The course of instruction for a radioprotection specialist and the characteristics which such a specialist should have are outlined. (JSR)

26464 (LA-5267-M) BIOHAZARDS MANUAL. Kraemer, P. M.; Flynn, P. L.; Talley, G. M.; Tobey, R. A.; Holland, L. M. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1974. 17p. Dep. NTIS $4.00.

Adapted from ORNL-TM-2854.

The problems of laboratory-acquired infections, oncogenic viruses, allergy to animal dander and sera, and carcinogens are reviewed. Infectious agents are classified, and recommendations for their containment are given. A few basic principles for the safe handling of hazardous agents are listed. (CH)

26465 FUTURE OF LARGE-SCALE RESEARCH CENTERS. Grillo, W. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt eV, Porz-Wahn, Ger.); Harig, H. D.; Kutschke, D. Atomwirt., Atomtech.; 18: No. 12, 566-568(Dec 1973). (In German).

In the FRG, a little later than in other countries, the large research centers especially for nuclear and space investigations, have to be prepared to slow down and change tasks after a phase of fast expansion. The authors visited the research centers in the USA, Great Britain, and France and compared the situation and the changes taking place in these countries to the German situation. It is evident that the organizational structure of German centers differs very much from that of the three countries visited. In Germany, the organization of the universities set the example for the structure of the centers, and even today the scientific self-administration plays an important role in those centers. (GE)

Mathematics and Computers

26466 (BNL-50404) BROOKNET-2: A GUIDE TO THE BROOKHAVEN ONLINE COMPUTER NETWORK. Campbell, G.; Fuchel, K.; Padwa, S. L. (Brookhaven National Lab., Upton, N.Y. (USA)). Jan 1974. Contract AT(30-1)-16. 46p. Dep. NTIS $4.00.

BROOKNET is a digital communications network which provides a data link between the Central Scientific Computing Facility (CSCF) and various user supplied computers at Brookhaven National Laboratory, using underground coaxial cable. A remote computer can use BROOKNET for one or both of the following functions: (1) Remote Input/Output of ordinary jobs to be run on one of the two Control Data Corporation (CDC) 6600's at the CSCF. (2) Fast, direct data transmission between the CSCF and an experimental area. The basics of operation of the system and some remotely initiated tasks are described. (MOW)

26467 (BNWL-B-325) SIMPLE PDP15 INTERFACE FOR THE VERSATEC SERIAL PRINTER. Kosorok, J. R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jan 1974. Contract AT(45-1)-1830. 24p. Dep. NTIS $3.25.

An interface was developed to go between the PDP 15/30 computer and the Versatec printer/plotter, model 200A, operating in the serial print mode. The interface construction involved fabricating a cable with two twisted pairs for a signal and a control line, speeding up the clock in the existing foreground teletype controller and changing less than a dozen wires in it. The associated I/O device handler allows the printer to be used as the listing device in the Digital Equipment Corporation Advanced Monitor Software System. With the handler, the printer is capable of printing 80 character lines at approximately 120 lines per minute. (auth)

26468 (CEA-CONF-2413) NEMATIC LIQUID CRYSTAL 1024 BITS PAGE COMPOSER. Labrunie, G.; Robert, J.; Borel, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 18 May 1973. 27p. (In French). (CONF-730352-1). Dep. NTIS (U. S. Sales Only) $3.50.

From meeting on optical storage of digital data; Aspen, Colorado, USA (19 Mar 1973).

Results are described for a nematic liquid crystal (N.L.C.) 1024 bits page composer. This display works in an ac cross-bar addressing mode, in order to utilize the electro-optic field effect of index modulation in N.L.C., and it acts as a spatial wave polarization modulator. (auth)

26469 (CONF-731210-1) POWER COMPARISONS OF TESTS FOR UNIFORMITY. Miller, F. L. Jr.; Quesenberry, C. P. (North Carolina State Univ., Raleigh (USA)). 1973. 21p. Dep. NTIS $3.25.

From joint statistical meetings of the American Statistical Association; New York, New York, USA (27 Dec 1973).

The results of a Monte Carlo Study to compare the power of seven test statistics for testing that a set of rv's are independently and identically distributed with a uniform distribution on (0,1) are reported. Empirical power is computed against four classes of alternatives. The Cramer—von Mises, the Pearson X^2_{10}, and a new statistic called Q are each found to have higher power against some alternatives. (auth)

26470 (COO-2118-49) PICTURE ANALYSIS BY GRAPH TRANSFORMATION. Masumi, A. E. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Oct 1973. Contract AT(11-1)-2118. 216p. (UIUCDCS-R-73-604). Dep. NTIS $13.00.

Thesis.

A methodology to analyze the pictorial information represented in a map-like image, and further name the objects most likely present in the scene based on the universe known to the system is developed. In contrast to conventional string language sentences which are formed by concatenating the primitives (symbols) in a string according to the language grammar, the pictorial sentences are basically formed of primitives which are located in a two-dimensional (or three-dimensional) space with much richer relational properties than simple adjacency. The possibility of describing the structural information of pictures as syntactical rules, employing a rich class of relations, was examined. The graphs are known to be extremely convenient and flexible to represent this kind of information. By expressing the syntactical properties of one class of pictures as a collection of graphs, it was shown that algorithms can be easily developed to parse objects or collections of objects which belong to this class. Further, this methodology is flexible enough to recognize incomplete objects, and has learning capabilities through adding and modifying the rules of the system. In addition, it was shown that a complete description of an object as a collection of graphs can be easily modified (rotated) to enable the system to recognize different projections of the object. (auth)

26471 (COO-2383-4) FLOWCHART-TO-SOURCE-CODE CONVERSION PROGRAM FOR GPSS/360. Purvy, R. E. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Dec 1973. Contract AT(11-1)-2383. 41p. (UIUCDCS-R-73-614). Dep. NTIS $4.25.

Thesis.

An interactive program is described which allows a user to specify a GPSS program as a block diagram. The user draws the block diagram using the Graphical Remote Access Support System (GRASS) and sends it to the remote computer where it is converted to an equivalent source program. He can then run the program, if desired, and have the output from GPSS routed back to the graphics terminal, selecting the portion for which hard copy is desired. The program is written in 360 Assembler Language. (auth)

26472 (EIR-247) COMPUTATION OF ANALYTICAL FUNCTIONS BY MEANS OF POWER-SERIES OR CONTINUED-FRACTIONS. Patry, J.; Gupta, S. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Nov 1973. 68p. Dep. NTIS (U. S. Sales Only) $5.50.

A theory was developed both for power series and continued-fractions valid for real and complex arguments. In case of complex arguments, moduli of the complex numbers should be considered. In the formulas for determining the necessary number of terms of a power-series, the order of magnitude of the function value can be taken instead of an exact function value. It is generally seen that up to 25 terms are needed to attain a relative error equal to the machine accuracy for power series as well as continued-fractions. The P-Algorithm was written in FORTRAN in single and double precisions for CDC 6000. It is recommended that double-precision versions of the P- and QD-Algorithms should be used, as the rounding errors cumulate rather fast. The assembler-versions of the subroutines, for calculating polynomials, continued-fractions of the normal and special forms and power-series are available in single-precision for CDC 6000 to carry out speed calculations. (auth)

26473 (IFA-MC-16-1973) MODIFICATION OF THE DOS RELEASE 27 SUPERVISOR FOR IBM SYSTEM 360/370 FOR MONOPROGRAMMING OPERATION. Marinescu, D. C. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.25.

A modification of the DOS supervisor of the IBM system 370/135 which has been installed at IFA in January 1973 is described. The new feature has been operational since April 1973 and is related to the possibility of controlling the time and the amount of printing for individual jobs in a job stream. On the basis of the information provided by the user on the job card, the job is allowed to run for a certain time and to print a certain number of lines; as soon as one of these two limits is exceeded the job is cancelled. The system timer and the line count are set after reading the job card when first call for the printer is attempted. It follows that the accounting for time and page is performed throughout all job steps not only for execution. Such a feature has proved its usefulness both for the users who can have their jobs run for a certain time (this is particularly useful when a job is tested) and for the computer center wishing to minimize the amount of time and paper wasted in unsuccessful attempts. (auth)

26474 (IJS-P-283) MARK: A PROGRAM FOR LEAST-SQUARES ESTIMATION OF NONLINEAR PARAMETERS. Smolej, V. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). Oct 1973. 33p. (In Slovenian). Dep. NTIS (U. S. Sales Only) $3.75.

A program solving the nonlinear problem of least squares is described. The algorithm used is described and its advantages over conventional methods discussed. The program has several useful possibilities available, like use of finite-difference derivatives, plotting option, possibility to fix one or several parameters sought. It uses several user-supplied routines which make the program very flexible. There examples of its use in different fields are supplied. (auth)

26475 (IS-3329) PICTORIAL REPRESENTATION OF THREE-DIMENSIONAL DISTRIBUTIONS THROUGH A PERSPECTIVE VIEW OF CONTOUR DIAGRAMS IN A SET OF PARALLEL PLANES. Dombek, M. G.; Donn, J. J.; Peirce, M.; Sundberg, K. R.; Ruedenberg, K. (Ames Lab., Iowa (USA)). Feb 1974. Contract W-7405-eng-82. 26p. Dep. NTIS $3.50.

A method of graphically exhibiting detailed information about a three-dimensional distribution function f(x,y,z) is described. Contour lines f = constant are drawn on a set of equidistant parallel planes that intersect the distribution, and a perspective view of all contours on all planes is displayed. Representative examples are given. (auth)

26476 (KFKI-73-71) PURELY ALGEBRAICAL CONSTRUCTION OF FIRST ORDER LOGICS. Andreka, H.; Nemeti, I.; Gergely, T. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Nov 1973. 50p. Dep. NTIS (U. S. Sales Only) $4.50.

Classical first order logics as interrelated purely algebraic constructions are introduced. To this end, a special class of universal algebras, namely the class of locally independently finite cylindric algebras, is defined. Some of its basic properties are investigated. The constructions of first order logics are based on this class, and the investigations of the logical properties are purely algebraic arguments based on the properties of this class of algebras. (auth)

26477 (KFK-PDV-10) MULI: MULTI LEVEL DIALOG SYSTEM, MULTI LEVEL DIALOG LANGUAGE: DESCRIPTION OF LANGUAGE AND SYSTEM. Namneck, P.; Schnarre, I.; Wagner, K. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F.R. Germany)). 11 Oct 1973. 157p. Dep. NTIS (U. S. Sales Only) $10.00.

A machine and problem independent "Multi Level Dialog Language" and its implementation, the "Multi Level Dialog System" are described. The system offers a choice of different language-levels, so that users with varying system knowledge have access to the same computer functions. The defined language may be modified and extended at any time, even during operation, for which no additional programming is required. The user has complete freedom in defining the computer action associated with a given input (i.e., with the semantics of this input). Furthermore the volume discusses the adaptation to a system (installation) and the adaptation to a selected problem (application) as well as possible subsets of the MULI-language and the MULI-system. This includes the definition of those parameters which are required to tailor a system to the special needs of a user. (auth)

26478 (KFK-PDV-11) MULTI: MULTI LEVEL DIALOG SYSTEM, AND MULTI LEVEL DIALOG LANGUAGE: CASE STUDIES FOR APPLICATION. Namneck, P.; Schnarre, I.; Wagner, K. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F. R. Germany)). 11 Oct 1973. 265p. Dep. NTIS (U. S. Sales Only) $12.25.

Six studies using the language are included. For each of these studies a computer system is selected and the required specifications are given. (auth)

26479 (ORNL-4887(Pt.B)) RANK ORDER PROBABILITIES; ONE-SAMPLE NORMAL SHIFT ALTERNATIVES. Part B. Statistical Applications. Lever, C. S. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 99p.

Let $X_1, \ldots, X_N$ be independent random variables normally distributed with mean θ and variance 1. The normal density function will be denoted by $f(x, \theta)$. If $x_1, \ldots, x_N$ are the observations and $y_1, \ldots, y_N$ are the absolute values of the observations arranged from smallest to largest, then $z = (z_1, \ldots, z_N)$ is defined to be the observed rank order where $z_i = 1$ if y_i is the absolute value of a positive number and $z_i = 0$ if y_i is the absolute value of a negative number. Corresponding to z is the random vector Z. There are 2^N possible values of Z and $P(Z = z|\theta) = N! \int_{0<u_1<} \ldots \int_{<u_N<\infty} \Pi_{i=1}^N f[u_i - (2z_i - 1)\theta]du_i$. Tables of $P(Z = z|\theta)$ to nine decimal places are presented for all z for $1 \leq N \leq 12$; θ = 0, .1, .2, .4, .6, .8, 1.0, 1.5, 2.0, 3.0. Various applications of these tables are presented, including (1) the small sample power of one-sample rank tests of symmetry such as the Wilcoxon signed rank test, the Fraser test, and the sign test against normal alternatives; (2) sequential one-sample procedures based on signed ranks and sums of signed ranks within groups with respect to normal alternatives. (auth)

26480 (SLA-74-5077) STRUCTURING A DATA BASE FOR ENGINEERING TEST DATA. Roehrig, C. E. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. 17p. (CONF-740210-2). Dep. NTIS $3.00.

From technical program-winter meeting; Los Alamos, New Mexico, USA (4 Feb 1974).

The data system at Sandia Laboratories is briefly reviewed. All phases from the point of determining that data, through the man/machine operations of creating a computerized data base, data analysis, and finally, data destruction are included. (auth)

26481 (SU-326-P-30-28-A) COMPUTATIONAL COMPLEX ANALYSIS. Henrici, P. (Stanford Univ., Calif. (USA). Dept. of Computer Science). Oct 1973. Contract AT(04-3)-326. 15p. (CONF-730852-1; STAN-CS-73-397). Dep. NTIS $3.00.

From conference on the influence of computing on mathematical research and education; Missoula, Montana, USA (13 Aug 1973).

The discussion concerns the merits of dialetic and algorithmic mathematics. Dialectic mathematics is defined to be a rigorously logical science where algorithmic mathematics is a tool for solving problems. (MOW)

26482 (UCID-16443) RECOG: PATTERN RECOGNITION ANALYSIS OF GENERALIZED DATA SETS. A User's Manual. Pritchard, R. H.; Bender, C. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Dec 1973. Contract W-7405-eng-48. 67p. Dep. NTIS $5.50.

Pattern recognition is a developing branch of artificial intelligence that has shown great promise in providing a general approach to solutions of a large class of data analysis problems in such diverse areas as medical diagnosis, environmental protection, materials science, production control, and the experimental physical sciences. The computer program RECOG is described. (MOW)

26483 (UCID-30084) WAMP: A USERS MANUAL FOR THE WIRE ANTENNA MODELING PROGRAM. Deadrick, F. J.; Miller, E. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Dec 1973. Contract W-7405-eng-48. 109p. Dep. NTIS $7.50.

Program WAMP is a Wire Antenna Modeling Program written in FORTRAN IV and applicable to arbitrary antenna and support structures. WAMP models an antenna as a series of interconnected straight wire segments, and solves the electromagnetic boundary value problem by numerically evaluating an electric field integral equation. Antennas may be analyzed in free space, over a perfect ground, a radial ground screen, or in the presence of any homogeneous media. Antenna input impedance, current distributions, near-electric fields and far-field radiation patterns are also calculated. The users manual covers both the theory and numerical techniques employed in WAMP. The program's input variables are defined, and illustrative examples are used to demonstrate the program's capabilities. (auth)

26484 INTERFACE BETWEEN A CONTROL DATA CORPORATION 6600 DIGITAL COMPUTER AND A DIGITAL EQUIPMENT CORPORATION PDP 11/20 DIGITAL COMPUTER (1 DEC 1971) (ENGINEERING MATERIALS). (Los Alamos Scientific Lab., N. Mex. (USA)). (CAPE-2388).

7 drawings.

Drawings which constitute a technical description of an interface between a Control Data Corporation 6600 digital computer and a Digital Equipment Corporation PDP 11/20 digital computer are presented. The interface consists of two main parts. The part connected directly to the 6600 is called the synchronizer. The part which connects directly to the PDP 11 is called the coupler. Drawings 72Y-168018 C sheets 18 through 24 describe the synchronizer. This equipment was designed and constructed at LASL for use in the Hydra computer network. (auth)

26485 IDENTIFICATION AND SYSTEM PARAMETER ESTIMATION. Part 1. Proceedings of the 3rd IFAC Symposium, The Hague, Netherlands, June 12–15, 1973. Eykhoff, P. (ed.). Amsterdam; North-Holland Publishing Company (1973). 555p. (CONF-730676–P1).

Separate abstracts were prepared for 2 of the 64 papers included. The remaining papers are outside the scope of NSA. (JWR)

For abstracts of individual papers see: 26148 and 26198.

26486 IDENTIFICATION AND SYSTEM PARAMETER ESTIMATION. Part 2. Proceedings of the 3rd IFAC Symposium, The Hague, Netherlands, June 12–15, 1973. Eykhoff, P. (ed.). Amsterdam; North-Holland Publishing Company (1973). 656p. (CONF-730676–P2).

Eighty-six theoretically-oriented papers are included in Part 2 of the Proceedings of the 3rd IFAC symposium dealing with identification and system parameter estimation. Sections are included of Round Tables and Exercises/Test cases. An abstract was prepared for a late paper on power generation and distribution. (MCW)

For an abstract of an individual paper see: 26420.

26487 ALGORITHM FOR THE EXACT REDUCTION OF A MATRIX TO FROBENIUS FORM USING MODULAR ARITHMETIC. I. Howell, J. A. (Los Alamos Scientific Lab., NM). Math. Comput.; 27: No. 124, 887-904(Oct 1973). (LA-UR-73-1131).

A description is given of the Danilewski algorithm for reducing a matrix to Frobenius form using rational arithmetic. This algorithm is modified for use over the field of integers modulo p. The modified algorithm yields exact integral factors of the characteristic polynomial. A description of the single-modulus algorithm is given. Part II contains a description of the multiple-modulus algorithm. Since different moduli may yield different factorizations, an algorithm is given for determining which factorizations are not correct factorizations over the integers of the characteristic polynomial. (auth)

Miscellaneous

26488 (CONF-7206100-2) DETERMINATION OF EQUILIBRIUM VACANCY DENSITY IN COPPER AND BRASS FROM POSITRON TRAPPING MEASUREMENTS AT TEMPERATURES TO THE MELTING POINT. MacKenzie, I. K. (Danmarks Tekniske Hoejskole, Lyngby). 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

From 3rd Nordic high temperature symposium; Riso, Denmark (7 Jun 1972).

The trapping of positrons at vacancy sites in some metals provides a new and sensitive method for the determination of equilibrium vacancy density and vacancy formation energy. Data are presented for Al, Cu, α-, β-, and γ-brass. A short description of the method and an account of the instrument costs are given. (Denmark)

26489 (ITF-73-157-P) EXCITONS, POLARITONS, AND LIGHT ABSORPTION BY MOLECULAR CRYSTALS. Davydov, A. S. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

A phenomenological theory of light transmission through an isotropic crystal when the light frequency falls in the exciton absorption-band range is presented. The concepts of polaritons and normal waves are introduced. The question of their roles in different phenomena of light interacting with a crystal is discussed. (auth)

26490 (JINR-E4-7624) STANDARD-BASIS OPERATOR METHOD IN THE GREEN-FUNCTION DIAGRAM TECHNIQUE OF MANY BODY SYSTEMS. I. Westwanski, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

Using the general statistical Wick theorem, the diagram technique for an arbitrary Hamiltonian, constructed from spin one operators is presented for the example of the Hamiltonian containing the following terms: Zeeman, uniaxial and biaxial crystal fields, isotropic Heisenberg and biquadratic exchange interactions. (auth)

26491 (JINR-E4-7625) STANDARD-BASIS OPERATOR METHOD IN THE GREEN-FUNCTION DIAGRAM TECHNIQUE OF MANY BODY SYSTEMS. II. Applications to Heisenberg Ferromagnet with Single-Ion Anisotropy. Westwanski, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

Using a previous diagrammatic technique, the correlation functions are calculated within the Heisenberg ferromagnet with single-ion anisotropy, up to order $(1/Z)^2$, where Z is the number of spins interacting with any given spin. In the zero limit of the anisotropy constant these functions take the form of those of Vaks et al. (auth)

26492 (RLO-2225-T-26-18) NITROGEN-TO-PHOSPHORUS RATIO IN THE PHOTIC ZONE OF THE SEA AND THE ELEMENTAL COMPOSITION OF THE PLANKTON. Banse, K. (Washington Univ., Seattle (USA). Dept. of Oceanography). [nd]. Contract AT(45-1)-2225. 12p. Dep. NTIS $3.00.

The ratio of removal of inorganic nitrogen and phosphate from the photic layer of the sea should not be interpreted as the elemental ratio in newly formed phytoplankton or particulate matter. (auth)

26493 (UCRL-51468) PROLATE AND OBLATE SPHEROIDAL WAVE FUNCTIONS OF COMPLEX ARGUMENT. Lytle, R. J.; Deadrick, F. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Oct 1973. Contract W-7405-eng-48. 47p. Dep. NTIS $4.00.

The spheroidal coordinate system and the solutions to the scalar Helmholtz wave equation in the spheroidal coordinate system are described. The methods of generating and sample numerical results for the eigenvalues, angle eigenfunctions, and radial eigenfunctions for complex expansion parameters are presented. (auth)

26494 AMAGAT TABLES (ENGINEERING MATERIALS). (California Univ., Livermore (USA). Lawrence Livermore Lab.). (CAPE-2383).

69 drawings.

26495 SCANNING ELECTRON MICROSCOPY: SYSTEMS AND APPLICATIONS 1973. Proceedings of a Conference Held at Newcastle upon Tyne, England, July 3-5, 1973. Conference Series No. 18. London; Institute of Physics (1973). 337p.

Separate abstracts were prepared for 3 of the 63 papers presented. (WHK)

For abstracts of individual papers see: 24328, 24329, and 24631.

Chemistry

26496 (CONF-7209103-(Absts.)) 3RD NATIONAL CONFERENCE OF PURE AND APPLIED PHYSICAL CHEMISTRY, BUCHAREST, ROMANIA, SEPTEMBER 4–7, 1972. Abstracts. (Centrul de Chimie Fizica, Bucharest (Romania)). 1972. 391p. (In several languages).

26497 (IS-T-623) MACROPOROUS RESINS FOR SORPTION AND CHROMATOGRAPHIC SEPARATION OF GASES. Chang, R. C. Y. (Ames Lab., Iowa (USA)). Nov 1973. Contract W-7405-eng-82. 38p. Dep. NTIS $4.00.

Thesis.

Several macroporous polystyrene, polyacrylate, and other macroporous resins are shown to be suitable as column packing materials for gas chromatographic separation of gases. Retention times of gases were determined and several complex gas mixtures were separated on columns packed only with macroporous resins. (DLC)

26498 (JINR-P12-7440) SEARCH FOR THE REGULARITIES IN THE CHANGE OF PHYSICAL–CHEMICAL PROPERTIES OF ELEMENT-HOMOLOGS AND THEIR COMPOUNDS. I. Normal Boiling Points of Halogen Compounds. Kolachkovski, A.; Norseev, Yu. V.; Nefedov, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 22p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

26499 (LBL-2335) STRUCTURAL INVESTIGATIONS OF TRANSITION METAL PENTACOORDINATION. Jurnak, F. A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1973. Contract W-7405-eng-48. 172p. Dep. NTIS $10.75.

Thesis.

Crystal and molecular structures are studied for the following: two salts containing the $[Ni(CN)_5]^{3-}$ anion (with $Cr(NH_3)_6$ and $Cr(NH_2CH_2CH_2CH_2NH_2)_3$); $[Co(CNC_6H_5)_5]$ $[ClO_4]_2 \cdot \frac{1}{2}$ $ClCH_2CH_2Cl$; and bromoacetyl derivatives of vitexin. The conformation of the $[Cr(NH_2CH_2CH_2CH_2NH_2)_3]^{3+}$ cation is also studied. (DLC)

26500 (MLM-1987) DIRECT METHODS OF CRYSTAL STRUCTURE ANALYSIS: A BIBLIOGRAPHY. Sullenger, D. B. (Mound Lab., Miamisburg, Ohio (USA)). 31 Jan 1974. Contract AT-33-1-GEN-53. 162p. Dep. NTIS $10.25.

This bibliography on direct methods of crystal structure analysis contains references to 1376 international scientific publications. It concentrates on derivation of appropriate techniques, their applications in specific instances, comments concerning the efficacy of the method relative to other approaches, etc. The tabulated publications date from 1927 through 1971 with an aim for comprehensiveness through 1970. (auth)

26501 (ORNL-tr-2792) USE OF $Mg(NO_3)_2-Zn(NO_3)_2$ MIXTURES FOR CONCENTRATING DILUTE HNO_3. Baranov, A. V.; Chentsova, L. I.; Rubtsov, Yu. I. (Oak Ridge National Lab., Tenn. (USA)). 1968. Translated by Martha Gerrard from pp 151-154 of Fizika, Khimiya i Khimicheskaya Tekhnologiya, Sbornik Materialov Nauchno-Tekhnicheskoi Konferentsii Rabotnikor Nauki, 1968. 4p. Dep. NTIS $3.00.

26502 (SC-RR-70-883) CHEMICAL ANALYSIS OF SOLID SURFACES BY SOFT X-RAY APPEARANCE POTENTIAL SPECTROSCOPY. Park, R. L.; Houston, J. E.; Schreiner, D. G. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1971. 17p. Dep. NTIS $3.00.

A simple spectrometer was devised for the chemical analysis of solid surfaces on the basis of the binding energies of core electrons. (DLC)

26503 (SLA-74-6011) ELECTROCHEMICAL STUDY OF THE PROPERTIES OF MAGNESIUM CHLORIDE IN MOLTEN LiCl AND KCl AND IN LiCl–KCl EUTECTIC. Le Varguerese, S. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1972. Translation of CEA-R-4392. 68p. Dep. NTIS $5.50.

Thesis.

A study of the behavior of magnesium chloride in solution in LiCl–KCl eutectic and in each one of the components of the eutectic taken separately is reported. The presence of water in the eutectic and in the magnesium chloride led us to study not only its elimination but also the products of the hydrolysis, in particular the species remaining in solution. For the same reasons, we studied the solubility of magnesium oxide. We have specified without attempting an exhaustive investigation, concepts relative to the influence of solute and solvent structure as a function of our results. The equipment used, the methods of dehydration and purification of the salts, and the study of the $LiCl-MgCl_2$ system are reported in detail in the appendix. (auth)

26504 (Y-1921) CHARACTERIZATION AND REPRODUCIBILITY OF PETROLEUM PITCHES. Smith, W. E.; Horne, O. J. Jr.; Napier, B. Jr. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1 Mar 1974. Contract W-7405-eng-26. 45p. Dep. NTIS $4.00.

An analytical study was designed to establish the reproducibility of a petroleum pitch system as a function of the sampling period, and to obtain information on the molecular structures and compositions of these materials. Samples of petroleum pitch and the feedstocks from which the pitches were made were received monthly from the vendor during a 12-month sampling period, and were subsequently analyzed along with control samples. Properties obtained included molecular weight and distribution analyses, softening points, viscosities, benzene insolubles, elemental compositions, and coke yields. Mouth-to-month variability in the properties of the feedstock was greater than that observed for the corresponding pitch samples, indicating that the pitch-producing process has a leveling effect on the precursor property differences. Studies on molecular structures present in pitch and feedstock materials were made using nuclear magnetic resonance techniques that allowed an estimation of sizes and compositions of aromatic and aliphatic groups, and the number of alkyl substituents per molecule. Models were suggested that fit these average properties. (auth)

26505 (Y-1929) COMPOSITION OF CORROSION FILMS ON LITHIUM HYDRIDE SURFACES AFTER EXPOSURE TO AIR. McLaughlin, J. F.; Cristy, S. S. (Oak Ridge Y-12 Plant, Tenn. (USA)). 11 Mar 1974. Contract W-7405-eng-26. 26p. Dep. NTIS $4.00.

An ion microprobe mass analyzer was used to investigate the reaction pathway for the formation of lithium hydroxide and lithium oxide on freshly cleaved lithium deuteride surfaces. Mass spectra were obtained from the lithium deuteride surfaces before and after exposure to room air, and the composition of the corrosion film was determined by depth-profiling methods. The corrosion film appears to be layered in the following manner: lithium hydroxide on lithium oxide on lithium deuteride. (auth)

Life Sciences

26506 (CEA-CONF-2376) INTERACTION OF ADP, ATRACTYLOSIDE, AND GUMMIFERIN ON THE ADP TRANSLOCASE OF THE INNER MITOCHONDRIAL MEMBRANE. Vignais, P. V.; Vignais, P. M.; Defaye, G.; Lauquin, G.; Doussiere, J.; Chabert, J.; Brandolin, G. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). [nd]. 13p. (CONF-7205104-2). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on mechanism in bioenergetica; Bari, Italy (1 May 1972).

Two specific inhibitors of the adenine nucleotide translocation, gummiferin (GUM), identified to 4-carboxyatractyloside and atractyloside (ATR), were labeled with ^{35}S and their binding properties to whole mitochondria and inner mitochondrial membrane vesicles used to monitor changes of membrane conformation induced by ADP. (auth)

26507 (CEA-CONF-2377) ^3H-METYRAPOL AS A TOOL FOR STUDIES OF INTERACTIONS OF DEOXYCORTICOSTERONE WITH ADRENAL CORTEX MITOCHONDRIA. Satre, M.; Lunardi, J.; Vignais, P. V. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). [nd]. 8p. (CONF-7205104-1). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on mechanism in bioenergetica; Bari, Italy (1 May 1972).

^3H-metyrapol was prepared by reduction of metyrapone with tritiated sodium borohydride. Metyrapol behaves like metyrapone as an inhibitor of the 11β-hydroxylation of deoxycorticosterone in adrenal cortex mitochondria and competes with metyrapone in binding tests. These results, and the ease of preparation of highly labeled ^3H-metyrapol, recommend ^3H-metyrapol as a probe of deoxycorticosterone interactions with adrenal cortex mitochondria. (auth)

26508 (COO-78-310) STRUCTURAL VARIATIONS AMONG THE CHROMOSOMES OF NORMAL HUMANS. Rustad, R. C.; Macintyre, M. N. (Case Western Reserve Univ., Cleveland, Ohio (USA)). 1973. 6p. (CONF-731132-1). Dep. NTIS $3.00.

From American Anthropological Association annual meeting; New Orleans, Louisiana, USA (28 Nov 1973).

26509 (COO-3154-4) LOSS OF ORGANIC AND INORGANIC MATERIALS FROM ABOVE-GROUND PLANT PARTS BY LEACHING. Final Report. Tukey, H. B. Jr. (Cornell Univ., Ithaca, N. Y. (USA). Dept. of Floriculture and Ornamental Horticulture). 1 Mar 1974. Contract AT(11-1)-3154. 27p. Dep. NTIS $3.50.

26510 (LA-UR-74-146) CHROMOSOME G-BANDING AND DNA CONSTANCY IN ANEUPLOID CELL POPULATIONS. Deaven, L. L.; Sanders, P. C.; Grilly, J. L.; Kraemer, P. M.; Petersen, D. F. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 28p. (CONF-731007-6). Dep. NTIS $3.50.

From 1st symposium on mammalian cells: probes and problems; Los Alamos, New Mexico, USA (17 Oct 1973).

Results are reported from studies using improved flow microfluorometry techniques that indicate that, although the DNA content of heteroploid cells is greater than that of diploid parent cells, there is little, if any, increase in variability of cell-to-cell DNA content and that the traditional mechanisms used to explain infrastem-line variability of chromosome number are inadequate. Chromosome banding analysis of several HeLa populations supported these conclusions. (CH)

26511 (ORNL-EMIC-3) CHEMICAL MUTAGENESIS. A Survey of the 1972 Literature. Wassom, J. S.; Shelby, M. D.; von Halle, E. S.; Barnard, W. J.; Miller, I. C.; Brown, M. M. (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. 372p. Dep. NTIS $20.75.

Some 2,500 references are presented to literature published during 1972 on chemical mutagenesis. The information is organized into seven sections or indexes. (CH)

26512 (ORO-3634-24) INVESTIGATION OF ALLOGRAFT REJECTION. Comprehensive Report, December 1, 1969–January 31, 1974. Haughton, G. (North Carolina Univ., Chapel Hill (USA). Dept. of Bacteriology and Immunology). 1974. Contract AT(40-1)-3634. 12p. Dep. NTIS $3.00.

Allograft rejection was studied in mice with emphasis on immunosuppression by passively administered antibodies, reversal of immunosuppression, genetic factors regulating skin graft rejection, and immune reactions to transplanted tumors. (CH)

26513 (RLO-2225-T-26-11) VENTRAL PARAPODIAL CIRRUS OF THE BENTHIC PHYLLODOCIDAE (POLYCHAETA), WITH SPECIAL REFERENCE TO CLAVADOCE HARTMAN AND BERGSTROEMIA BANSE. Banse, K. (Washington Univ., Seattle (USA). Dept. of Oceanography). 1972. Contract AT(45-1)-2225. 19p. Dep. NTIS $3.00.

Several benthic Phyllodocidae (annelids) have a large reniform ventral parapodial cirrus with the long axis oblique, or at a right angle, to the acicula. The form and orientation of the cirrus is introduced as an auxiliary diagnostic character on the generic level, because this type of cirrus is restricted to certain genera established on the basis of other criteria previously. (auth)

26514 (UR-3490-402) LONG-TERM BEHAVIORAL CONSEQUENCES OF EXPOSURE TO DRUGS AND POLLUTANTS. Weiss, B. (Rochester Univ., N. Y. (USA). Dept. of Radiation

Biology and Biophysics). 1973. 22p. (CONF-730678-1). Dep. NTIS $3.25.

Problems in the evaluation of long-term consequences of exposure to both psychoactive drugs and environmental pollutants are discussed with emphasis on the pathological effects of tranquilizer treatment and exposure to heavy metal environmental contaminants (manganese and mercury) in man and monkeys. (CH)

26515 (UR-3490-416) TOOLS FOR THE ASSESSMENT OF BEHAVIORAL TOXICITY. Weiss, B. (Rochester Univ., N. Y. (USA). Dept. of Radiation Biology and Biophysics). 1973. 13p. (CONF-730678-2). Dep. NTIS $3.00.

Behavioral toxicology, in the context of occupational health, is seen as a tool for the detection of sub-clinical intoxication of man following exposure to toxic chemicals. (CH)

26516 (US-IBP-73-3(Vol.3)(No.3)) ABSTRACTS: US-INTERNATIONAL BIOLOGICAL PROGRAM ECOSYSTEM ANALYSIS STUDIES. Ferguson, N. (ed.). (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 55p. Dep. NTIS $4.75.

26517 (US-IBP-73-4(Vol.4)(No.4)) ABSTRACTS: US-INTERNATIONAL BIOLOGICAL PROGRAM ECOSYSTEM ANALYSIS STUDIES. Ferguson, N. (ed.). (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 61p. Dep. NTIS $5.25.

Materials

26518 (COO-1569-113) SPECIFIC HEAT MEASUREMENTS AT THE SPIN-REORIENTATION TRANSITION IN $YbFeO_3$. Sjolander, G. W. (Minnesota Univ., Minneapolis (USA)). [nd]. Contract AT[11-1]-1569. 38p. Dep. NTIS $4.00.

Thesis.

The specific heat was measured from 2.55 to 15.7°K, first with no external magnetic field, and then with magnetic fields along the c-axis and a-axis of intensity of 1000, 3000, and 5800 Oe. Two specific heat anomalies were observed: a Schottky anomaly caused by the ground state exchange splitting of the Yb^{3+}, and spin reorientation of the Fe sublattice. (DLC)

26519 (COO-3150-19) SOLID STATE PHYSICS; MAGNETIC PHENOMENA. Progress Report, 1 January 1973–31 December 1973. Bowers, R.; Silsbee, R. H. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Atomic and Solid State Physics). 1973. Contract AT(11-1)-3150. 18p. Dep NTIS $3.00.

Research is summarized on the following topics: ESR in metals, magnetic phenomena and electronic structure (radio frequency size effect and acoustic wave generation in metals). (DLC)

26520 (COO-3151-36) EXPERIMENTAL PHONON PHYSICS. Progress Report, April 1, 1973–March 31, 1974. Pohl, R. O.; Sievers, A. J. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Atomic and Solid State Physics). 1974. Contract A(11-1)-3151. 19p. Dep. NTIS $3.00.

Research on the following topics is summarized: specific heat anomaly in glasses and compressed ceramics, pressure effects on defect modes in alkali metal halide crystals, for infrared absorption of glasses, for infrared properties of metals, and various miscellaneous projects. (22 references) (DLC)

26521 (EUR-5052) CALCULATED DISTRIBUTION OF THE CHEMICAL SPECIES OF COPPER, ZINC, CADMIUM, AND LEAD IN 16 LAKES OF NORTHERN ITALY. Baudouin, M. F.; Scoppa, P. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center; Commission of the European Communities, Luxembourg). Feb 1974. 88p. Dep. NTIS (U. S. Sales Only) $6.50.

26522 (JUL-992-RB) THERMAL CONDUCTIVITY OF FIBROUS MATERIALS: METHODS OF CALCULATION. Broeckerhoff, P. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorbauelemente). Aug 1973. 50p. (In German). Dep. NTIS (U. S. Sales Only) $4.50.

An attempt is made to calculate the effective overall thermal conductivity of fibrous materials by means of relations published in the literature. The calculation of the various factors such as gas and solid materials conductivity as well as radiant heat transfer is discussed in detail. Free convection is not taken into account as satisfactory calculation of this factor seems unlikely. Within certain ranges, particularly at low temperatures, good agreement is found between measured values of other authors and the presented results. At high temperatures, however, there are numerous deviations, due to the following two reasons: 1) The relation used to calculate the radiant heat transfer does not comply with actual conditions. 2) The effect of free convection has to be taken into account. The curve for the effective thermal conductivity shows a minimum if plotted as a function of the packing density, another important parameter besides the fiber diameter. The gases used for the experiments were helium and air. (GE)

26523 (LBL-2207) CORROSION FATIGUE PROPERTIES OF SURGICAL IMPLANT MATERIALS. Charo, I. F. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1973. Contract W-7405-eng-48. 44p. Dep. NTIS $4.25.

Thesis.

Corrosion resistance was measured both statically and dynamically on nickel, titanium, and stainless steel alloys in Ringer's solution. (DLC)

26524 (LBL-2264) INTERFEROMETRY OF SOLID THIN FILMS. Brown, C. R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1973. Contract W-7405-eng-48. 137p. Dep. NTIS $9.00.

Thesis.

Experiments were conducted to determine the validity of previously derived interference color series and the accuracy obtainable by using white light interference for measuring the thickness of thin, transparent films on metal substrates. Film-thickness profiles were derived from observed interference colors and compared to profiles derived from two different step-height measurements that were independent of the optical properties of film and substrate. In addition, film thickness was determined by two other optical techniques, spectroscopy and ellipsometry. Satisfactory agreement was obtained with film profiles obtained by visual interpretation of interference colors and use of previously determined color series. The practical distinction between neighboring hues is not as sharp as theoretically predicted. But colors of lower saturation than previously assumed can still be observed in practice. (auth)

26525 (UCID-16438) PARTICIPATION OF LLL IN JSEXP: CALIBRATION OF MP35N ALLOY. Varosh, R.; Mahler, J.; Nidick, E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Jan 1974. Contract W-7405-eng-48. 36p. Dep. NTIS $4.00.

Gas gun experiments were conducted to determine the equation of state for soda-lime glass for a multiphase alloy MP35N (35% Co, 35% Ni, 20% Cr, 10% Mo) and to determine the piezoresistive coefficient of a Manganin gage. (DLC)

Physics

26526 (ANL-CT-73-45824-7) SOME MOISTURE EFFECTS ON REUTER–STOKES MINERAL-INSULATED CABLE, TYPE RSE 2-0041. Hardtke, F. C.; Cassidy, C. (Argonne National Lab., Ill. (USA)). 15 Dec 1973. 31p. AT.

The effect of ambient-air moisture on one of the two previously tested Reuter–Stokes cables was reexamined, this time using a 23-inch oven and Anhydrone as the desiccant. With the desiccant applied to the high-temperature end, the large improvement in the breakdown-pulse-noise (BPN) threshold voltage and cable resistance reported previously (ANL-CT-73-45824-5) was again observed. By selectively heating sections of the cable near either end, there was evidence that moisture could be purged from within the cable; a measure in the bulk cable of a very low gas-diffusion coefficient approximating 1.6 inches $hour^{-1}$ $atmosphere^{-1}$ was obtained, and there was evidence that a desorption process, possibly that of water vapor emission at about 400°F, may be causing BPN in the bulk cable. (12 fig) (auth)

26527 (IPP-4-113) DETECTION OF ULTRASHORT CO_2 LASER PULSES USING THE OPTICAL KERR EFFECT. Baumhacker, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Dec 1973. 18p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

A new experimental method which is capable of measuring short CO_2 laser pulses using fast detectors for the visible region is described. The theoretical time resolution is about 30 ps. The detection of 1.3 ns CO_2 laser pulses with a time resolution of 500 ps is described. (auth)

26528 (KFKI-73-65) ROTATING SAMPLE MAGNETOMETER. Kisdi-Koszo, E.; Neuprandt, G.; Zimmer, G. J. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Nov 1973. 7p. Dep. NTIS (U. S. Sales Only) $3.00.

A rotating sample magnetometer, optimized to measure magnetic anisotropy, is described. The design offers definite advantages in simplicity, ease of operation and accuracy. The driving motor, the shaft-position encoder and a long, interchangeable rod with the sample are arranged coaxially for easy and reproducible sample-changing. A special pick-up coil system with high discrimination against electrical noises is used. The sensitivity of this system is highly uniform, rendering the inaccuracy due to slight displacement of the sample negligible. The lock-in technique is adopted to extract the desired information. Typical data are presented. (auth)

26529 (LA-5491-MS) DEVELOPMENT OF A LASL WHOLE-AIR SAMPLER FOR WB-57F AIRCRAFT. Glenn, R. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1974. Contract W-7405-eng-36. 8p. Dep. NTIS $4.00.

A whole-air sampler was developed for collecting samples of stratospheric air at ambient pressures for laboratory analysis. The principle of operation is to evacuate the sample containers, fly them to sampling altitude, open the remotely operated vacuum valves, and take in ambient air through a suitable air delivery system until the internal sample pressure equilibrates with ambient. This system was designed for use aboard the WB-57F aircraft. The first test series was flown and certain mechanical problems uncovered. Conclusions and recommendations for system improvement and future investigations are presented. (auth)

26530 (LA-5496-MS) SOFT APERTURES FOR REDUCING DAMAGE IN HIGH-POWER LASER-AMPLIFIER SYSTEMS. Campillo, A. J.; Carpenter, B.; Newnam, B. E.; Shapiro, S. L. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1974. Contract W-7405-eng-36. 3p. Dep. NTIS $4.00.

Soft apertures have been constructed for tailoring the spatial profile of a light beam to minimize harmful diffraction effects that lead to self-focusing and consequent damage while still enabling substantial energy extraction from amplifiers. (auth)

26531 (MLM-2079) IMPROVED CABLE LOCK FOR AMPHENOL SERIES 80 AND 91 CONNECTORS. Otto, G. W. (Mound Lab., Miamisburg, Ohio (USA)). 8 Feb 1974. Contract AT-33-1-GEN-53. 7p. Dep. NTIS $3.00.

Some simple modifications are described that may be made to improve AMPHENOL Series 80 and 91 connectors. Although the modification was made for application in calorimeter instrumentation, some suggestions are made for utilization that would apply to a wider range of electronic equipment that might incorporate these types of connectors. (auth)

26532 (ORNL-tr-2751) ULTRASONIC RESEARCH IN THE TESTING OF FABRICATED SURFACES. Wawra, H. Translated by Robert H. Kernohan from Werkstatt Betr.; 105: No. 11, 829-831(1972). 16p. Dep. NTIS $3.00.

26533 (SLA-73-943) EFFECTS OF ELECTRICAL PROBING ON BEAM LEAD BONDING. Bushmire, D. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1974. Contract AT(29-1)-789. 20p. Dep. NTIS $3.00.

This process evaluation was performed to determine the effect of electrical probing on beam lead bonding. Visual inspection of beam lead devices has shown that various amounts of physical damage to the gold plated beams occur during electrical probing. This report describes the results of beam lead bonding on devices that have received various amounts of physical damage on the beam due to electrical probing. The amount of device beam damage is related to the probe control rather than the number of times the devices are probed. It appears that 100% visual inspection is the most effective method of identifying "good" or "bad" beams after probing. (auth)

26534 (SLA-73-1018) STABAN: AN INTERACTIVE GRAPHIC COMPUTERIZED STABILITY ANALYSIS PROGRAM. Wimber, B. J.; Horton, R. N. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1974. Contract AT(29-1)-789. 53p. Dep. NTIS $4.75.

This document describes an interactive graphic computerized stability analysis program (STABAN). Control system root locus plots, amplitude response characteristics, and attendant stability parameters are made available for interactive computer manipulation. Examples of the use of STABAN are included. (auth)

26535 (SLL-74-5202) DETERMINATION OF THERMAL CONDUCTIVITY COEFFICIENT VIA NON-EQUILIBRIUM MOLECULAR DYNAMICS. Ashurst, W. T. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1974. Contract AT(29-1)-789. 11p. (CONF-731139-1). Dep. NTIS $3.00.

From 13th international conference on thermal conductivity; Rolla, Missouri, USA (5 Nov 1973).

The method of nonequilibrium molecular dynamics was developed to simulate dense fluid transport of momentum and energy. This new method also allows determination of nonequilibrium distribution functions. The thermal conductivity coefficient was calculated for soft-spheres and Lennard-Jones atoms. For the density and temperature range investigated, the results appear to be in agreement with the Enskog rigid-sphere approximation for these systems. This is similar to the agreement with exact rigid-sphere results found by Alder, Gass and Wainwright. However, this is not the case for momentum transport. The Enskog theory for shear viscosity coefficient has large deviations from exact results. The calculated Lennard-Jones excess thermal conductivity coefficient (that part above the zero density temperature dependence) agrees with the experimental argon density dependence. (auth)

26536 (UCID-30086) APT III XYLO POST PROCESSOR. Gong, T. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Jan 1974. Contract W-7405-eng-48. 25p. Dep. NTIS $3.25.

This report is a user manual for personnel at LLL who are experienced in using the APT III XYLO post processor to gauge mechanical parts. As such, the report details the procedures and format specifications required to operate the automatically programmed tool (APT) computer program. (auth)

26537 (UCRL-13592) FINAL REPORT [ON COMPUTER SIMULATION OF A PROBLEM IN THERMOELASTICITY]. Barnes, F. S.; Tippet, J.; Kalfon, C. (Colorado Univ., Boulder (USA). Dept. of Electrical Engineering). Dec 1973. Subcontract 8601809. 49p. Dep NTIS $4.50.

For Univ. of California, Livermore.

The results of a computer simulation of a problem in thermoelasticity are presented. The problem is concerned with the dynamic stresses that are created in a hollow, cylindrical tube when the inside surface temperature is suddenly raised. This model was chosen to simulate what actually happens when a flashlamp is fired. The data presented indicates that a radial, tensional wave is produced whose amplitude is a significant fraction of the breaking strength of quartz. In addition, an experimental investigation of the parameters that affect lamp lifetime and explosion energy was undertaken. A direct correlation was found between the amount of compressive stress initially present in the outer wall of a flashlamp and its ultimate explosion energy. (auth)

26538 (UCRL-51130(Vol.12)) FINAL REPORT ON THE DEVELOPMENT OF THE GEOGRAPHIC POSITION LOCATOR (GPL). Volume 12. Data Reduction A3FIX: Subroutine. Niven, W. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Jan 1972. Contract W-7405-eng-48. 83p. Dep. NTIS $5.45.

The long-term position accuracy of an inertial navigation system depends primarily on the ability of the gyroscopes to maintain a near-perfect reference orientation. Small imperfections in the gyroscopes cause them to drift slowly away from their initial orientation, thereby producing errors in the system's calculations of position. The A3FIX is a computer program subroutine developed to estimate inertial navigation system gyro drift rates with the navigator stopped or moving slowly. It processes data of the navigation system's position error to arrive at estimates of the north–south and vertical gyro drift rates. It also computes changes in the east–west gyro drift rate if the navigator is stopped and if data on the system's azimuth error changes are also available. The report describes the subroutine, its capabilities, and gives examples of gyro drift rate estimates that were computed during the testing of a high quality inertial system under the PASSPORT program at the Lawrence Livermore Laboratory. The appendices provide mathematical derivations of the estimation equations that are used in the subroutine, a discussion of the estimation errors, and a program listing and flow diagram. The appendices also contain a derivation of closed form solutions to the navigation equations to clarify the effects that motion and time-varying drift rates induce in the phase-plane relationships between the Schuler-filtered errors in latitude and azimuth and between the Schuler-filtered errors in latitude and longitude. (auth)

26539 (UCRL-51489) THEORETICAL DESCRIPTION OF THE INTERACTION OF A PULSED LASER AND A TARGET IN AN AIR ENVIRONMENT. Edwards, A.; Ferriter, N.; Fleck, J. A. Jr.; Winslow, A. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Nov 1973. Contract W-7405-eng-48. 104p. Dep. NTIS $5.45.

A comprehensive theoretical modeling is described for a pulsed laser beam interacting with an aluminum target in the presence of an air atmosphere. Calculations include the details of target heating from ambient temperature through vaporization and ionization and allow the description of laser-supported detonation (LSD) waves in air. Calculations are based on a nonequilibrium three-temperature model. They also include the effects of two-dimensional Lagrangian hydrodynamics, diffusion of electron and heavy-particle temperatures, and accurate equations of state for air and aluminum. The resulting model yields realistic values of the maintenance threshold for LSD waves in air. Calculated detonation-wave velocities, surface pressures, and two-dimensional wave properties are in good agreement with experimental measurements. This leads to confidence in the code as an extrapolating tool for the effects of high-power lasers. The results obtained from the target interaction calculations have been used as input for material-response calculations that determine the nature of high-power laser damage to aluminum plates. (auth)

26540 (UCRL-51496) MAGNETICALLY ACCELERATED FLYER PLATES FOR USE IN IMPACT FRACTURE STUDIES. Snowden, W. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Dec 1973. Contract W-7405-eng-48. 49p. Dep NTIS $4.00.

A magnetic hammer system developed for use in impact fracture studies involving thin plates of glass and glass-ceramic materials is described. Forces of magnetic repulsion are used to accelerate flat metal flyers of Al, Cu, and Ni. An intensive study of the motion of Al flyers has been completed. Useful impact velocities from 0.022 mm/μsec to 0.279 mm/μsec were measured. These velocities correspond to pressures of approximately 2 to 25 kbar for impacts on glass having an acoustic impedance close to that for Al. Flyer velocities were reproducible to within 5%, and impact times were reproducible to within 2 μsec. A method of estimating flyer velocities from current traces was found to give values within 15% of those determined experimentally. (auth)

26541 (UCRL-74851) USE OF FRONT-SURFACE TECHNIQUES IN LUMINESCENT SPECTROSCOPY. Mode, V. A.; Sisson, D. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Nov 1973. 11p. (CONF-731140-1). Dep. NTIS $3.00.

From Pacific conference on chemistry and spectroscopy; San Diego, California, USA (2 Nov 1973).

Techniques for making corrected front-surface fluorescence measurements on an Aminco–Bowman Spectrophotofluorometer are described. This method was used for instrument calibration, for measurement of quantum efficiencies, and for measuring fluorescence from solids. The primary source of error in these measurements is the nonlinear absorption and emission (inner-filter effect) between sample and standard which can result in errors of 30% or more. A mathematical algorithm which will correct for this effect was developed. It has been possible to determine the quantum efficiency of quinine bisulfate solutions over a much larger concentration range than was previously possible. Results agree to within 2% of previously published data. (auth)

26542 (UCRL-75185) DNA PRESENTATION. Shay, H. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Oct 1973. Contract W-7405-eng-48. 30p. (CONF-731134-1). Dep NTIS $3.50.

From DNA meeting; Columbus, Ohio, USA (5 Nov 1973).

LLL development work toward providing an x-ray simulator capable of providing copious fluxes of hard x radiation is discussed. The laser program is briefly outlined. The holographic interferometer work is also described. (MOW)

26543 (UCRL-75416) PROGRAMMABLE CONTROL SYSTEM. Young, R. H. Jr. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Feb 1974. Contract W-7405-eng-48. 6p. (CONF-740307-1). Dep. NTIS $3.00.

From symposium on automatic controls; Milwaukee, Wisconsin, USA (28 Mar 1974).

The intel MCS-8 microprocessor is used as the center of a stored program controller for a two-axis point-to-point machine tool. It checks each axis position through dual "noise-operated" channels and records positional accuracy and electronic error. The machine tool consists of a part axis and a drill axis, which can be rotated about the center of a spherical section pointing toward the part axis "shell" of the section. The part is rotated in conjunction with the drill axis to enable a hole to be drilled at any point. The entire part program is stored in memory enabling immediate random access without error of positional data. The control enables operator interaction with the software as well as manual control of the machine movement. (auth)

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